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Effect of Moore Method of Teaching on Students' Performance in Gamma and Beta Function in Mathematical and Applied Statistics

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Abstract: ***The study investigated the effect of Moore Method of Teaching on Students' Performance in Gamma and Beta Function in Mathematical and Applied Statistics at Mukuba University. The design for the study was quasi-experimental control group pre-test and post-test design. Sample for the study consisted of 40third year students at Mukuba University who were not repeating statistics. Data was collected using Gamma and Beta Function Performance Test (GBFPT). Pre-test and Post-test questions were given to both groups. The class was purposively selected to be the research subject. Random assignment was conducted to come up with two groups. A coin was tossed once to come up with two groups. The head represented the experimental group while the tail represented the control group. Experimental group was taught using Moore approach while the control group was taught using conventional learning approach. The experimental group consisted of 20 students while the control group had the same number of students as the experimental group. Data for the study was analysed using mean, standard deviation, Independent Sample T-Test and Analysis of Variance (ANOVA). The null hypothesis was tested at 5% significance level. The findings of the study revealed that the Moore Method of Learning improved students' academic performance in Mathematical and Applied Statistics at Mukuba University. Lecturers at Mukuba University are encouraged to use Moore Learning Approach as a way of improving their students' achievement in mathematics. The study also recommended that during peer teaching students should incorporate Moore 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.***

Keywords: Moore Learning Approach, Conventional Learning Approach, Performance

1. Introduction

The future of each and every country depends on the quality of education being offered in universities and colleges. Education is considered as the cornerstone for the development and sustainability of the economy of the country. In spite of the significant role that statistics plays in society, most of the students at Mukuba University find Mathematical and Applied Statistics (MAT 350) difficult course to pass in third year. The main purpose of teaching at any level of education is to bring the best out of the learner. In order to facilitate a smooth transmission of knowledge to students, lecturers should apply an appropriate teaching method that suits best for each lesson taught. In many cases, poor academic performance by many students is attributed to lecturers more specifically to an ineffective method of teaching. The motivation for this study stems from the researchers' observation that Mathematical and Applied Statistics (MAT 350) has been and is still posing a number of challenges to the students who are majoring Mathematics in third year at Mukuba University. For instance, in 2015, out of 190 candidates who registered for MAT 350 in the 2015 academic year, 88 candidates representing 46.3% were not examined (not legible to write examination). Those with below 40% continuous assessment at Mukuba University are not legible to write examination. In 2016, out of 151 candidates who sat for MAT 350 examination in the 2016 academic year, only 36 candidates representing approximately 24% passed the course while approximately (76%) failed the course. According to The Post 04 November 2012 Issue No: 246, Mukuba University formerly Copperbelt Secondary Teachers College (COSETCO) in Zambia- Kitwe was upgraded into a university in 2012. Having 76% failure rate in applied statistics for a new university is a worrying thing. The 2017 academic year results showed that the situation has not improved. Out of 100 candidates who sat for MAT 350 examination in the 2017 academic year only 37 candidates, representing 37% passed the course while 63 (63%) failed the course. The study investigated the effectiveness of the Moore method of teaching on students' academic performance in Gamma and Beta function in Mathematical and Applied Statistics at Mukuba University.

The Moore Method, named after the eminent topologist Robert Lee Moore (1882-1974), is perhaps the most well-known process in the world for training research mathematicians. According to Chris (2006), Moore-method teaching has been associated with pedagogies including discovery-based, inquiry-based, student-centered, Socratic, and constructivist, yet it is not encompassed by these. The majority of a Moore-method mathematics course will consist of students' presentations of solutions they produce independently from material provided by the instructor. Such a course meets the students where they are mathematically, guides them at a fair and challenging pace through the material, and requires them to construct and present the key mathematical ideas of the subject before their peers, a discerning but supportive audience. The instructor plays the role of coach, mentor, collaborator, guide, and occasional cheerleader

1.2 Hypothesis

Null Hypothesis

H_0: There is no statistically significant difference in performance in Gamma and Beta Functionin statistics between students who were taught using Moore Learning Approach and students taught using Conventional Learning Approach.

Alternative Hypothesis

H_1: There is a statistically significant difference in performance in Gamma and Beta Functionsin statistics between students who were taught using Moore Learning Approach and students taught using Conventional Learning Approach.

2. Methodology

2.1 Research Design

The purpose of the study was to investigate the effect of Moore Method of Teaching on Students' Performance in Gamma and Beta Function in Mathematical and Applied **S**tatistics at Mukuba University. According to Ranjit (2011),a research design is a plan, structure and strategy of investigation so conceived as to obtain answers to research questions or problems. The plan is the complete scheme or programme of the research. It includes an outline of what the investigator will do from writing the hypotheses and their operational implications to the final analysis of data. The study used mix methods approach in order to observe the effect of the Moore Method of Teaching. 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 Gamma and Beta lessons whereas quantitative data was gathered from the pre-test and post-test results. Finding out about the effect of the Moore Method of Teaching on students' performance towards Gamma and Beta function was done quantitatively using Gamma and Beta Function Performance Test (GBFPT).

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 (Moore Method of Teaching) on the dependent variable (performance). This was Pre-test Post-test control group. Questions in the pre-test were based on Analysis of Variance (Randomised Block Design) and finding the Moment Generating Function, mean and variance of $\left(\frac{1}{3}\right)^x$ while questions on post-test were based on Gamma and Beta Functions. The experimental group studied Gamma and Beta Functions using the Moore method of teaching while the control group studied Gamma and Beta Functions using conventional learning method of teaching.

The following structure shows the experimental design that was employed in the study.

$$O_1 \quad X \quad O_2$$

$$O_1 \quad - \quad O_2$$

In the structure above,

O_1Were the observations made during the pre-test measures. Both the experimental and control group were given pre-test questions to check if they were academically equivalent at the beginning of the study.

X was the treatment employed in order to assess the effect on students' performance in Gamma and Beta Function. The experimental group was taught using the Moore approach while the control group was taught using conventional learning approach.

O_2Were the observations made during the post-test. Both the experimental and the control groups were given Gamma and Beta Function Performance Test as post-test measures. Then comparisons were made between pre-test and post-test performance between groups. The significant differences in performance in Gamma and Beta Function between the two groups were as the result of treatment (The Moore Method of Teaching).

2.2Target Population

Target population is the set of units to be studied (Robert el at, 2004). The population of this study included all the students who were studying statistics in third year in the 2018 academic year at Mukuba University. Mukuba University has a population of60students who are studying (MAT 350).

2.3 Sampling and Sampling Procedures

There was only one class for third year Mathematics at Mukuba University who were studying MAT 350 in the 2018 academic year. Data was collected using Gamma and Beta Functions Performance Test (GBFPT)). Pre-test and Post-test questions were given to both groups. The sample for the study comprised 40 third year students who were not repeating statistics. Therefore, the class was purposively selected to be the research subject. Random assignment was conducted to come up with two groups. A coin was tossed once to come up with two groups. The head represented the experimental group while the tail represented the control group. Experimental group was taught using Moore approach while the control group was taught using conventional learning approach. The experimental group consisted of 20 students while the control group consisted of the same number of students as the experimental group who were taught using the conventional learning method.

2.4 Data Collection Instrument/Techniques/Methods

The dependent variable in the study was performance in Gamma and Beta Function. To assess performance of

students in Gamma and Beta Function, 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 to collect data.

3. Results of the Study

3.1 The Pre-Test and Post-Test

The study investigated the effect of Moore Method of Teaching on Students' Performance in Gamma and Beta Function in Mathematical and Applied **S**tatistics at Mukuba University. At the beginning of the study, both the experimental and control group were pretested with questions in statistics involving Analysis of Variance (Randomised Block Design) and finding the Moment Generating Function, mean and variance of $\left(\frac{1}{3}\right)^x$. 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 Moore method and conventional learning method had on the performance of the students, both the experimental and control group were tested (Post-test) using Gamma and Beta Functions Performance Test.

3.2 Test for Normality

Statistical errors are common in most literature. The assumption of normality should be checked before analysing data when comparing the means of two or more groups because the validity of the results depend on the test of normality. In order to test for normality, we need to test whether a sample of observations comes from a normal distribution (Henry, 2002). Normality is one of the most common assumptions made in the development and use of statistical procedures. According to Pallant (2007), one of the methods used to test if the scores are normally distributed is Kolmogorov-Smirnov test. Kolmogorov-Smirnov test and Shapiro-Wilks test. Kolmogorov-Smirnov test works best if the sample size is more than fifty (50). However, the sample size of this study is less than fifty (50). Shapiro-Wilks test was used to test for normality of the data.

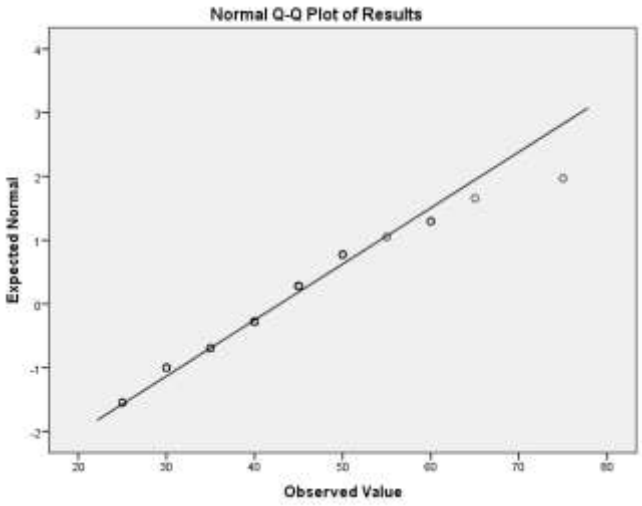

Figure 3.1: Normal Q-Q Plot

Table 3.1: Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
Results	.151	40	.022	.949	40	.068

From Table 3.1 above, the scores show that the two groups were normally distributed. From Table 3.1 above, we fail to reject H_0 since the P-value $= 0.068 > 0.05$ and we can conclude that the sample of observations comes from a normal distribution. Figure 3.1 above shows the normal probability plots (Normal Q-Q Plot). According to Pallant (2007), in the Normal Q-Q Plot the straight line suggests a normal distribution. In this plot, the observed value for each score is plotted against the expected value from the normal distribution. Since the data for the two groups was normally distributed, an independent samples t-test was used to analyse the data for pre-test and post-test scores.

Table 3.2: Analysis of the pre-test scores

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Results	Experimental	20	43.25	10.295	2.302
	Control	20	42.50	12.618	2.821

In the Group Statistics box above in Table 3.2, the mean for the control group was 42.50 while the mean for the experimental group was 43.25. The standard deviation for the control group was 12.618 and 10.295 for the experimental group. The number of participants in the control group was 20 whereas in the experimental group were 20 as well. The experimental group performance means (43.25) and the control group performance mean (42.50) indicated the equality of the two groups' performance.

Table 3.3: Analysis of the pre-test scores

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Lower	95% Confidence Upper
Results	Equal variances assumed	.573	.454	.206	38	.838	.750	3.641	-6.622	8.122
	Equal variances not assumed			.206	36.529	.838	.750	3.641	-6.631	8.131

From Table 3.3 above, using independent sample t-test for equality of means, we fail to reject H_0 since the P-value $= 0.838 > 0.05$ 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: What is the effect of the Moore Method of Teaching on Students' Performance in Gamma and Beta Function?

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

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Results	Experimenta	20	58.95	22.085	4.938
	Control	20	33.80	18.375	4.109

In the Group Statistics box above in Table 3.3, the mean for the control group was 33.8 while the mean for the experimental group was 58.95. The experimental group performance mean (58.95) and the control group performance mean (33.8) indicated that the performance of the two groups was not equal. That is students in the experimental group (those taught using Moore Method of Teaching) performed better than those taught using conventional learning approach.

Table 3.4: ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	6325.225	1	6325.225	15.327	.000
Within Groups	15682.150	38	412.688		
Total	22007.375	39			

Using the ANOVA Table 3.4 above, we reject H_0 since the P-value $= 0.000 < 0.05$ and conclude that there was a statistically significant difference in performance in Gamma and Beta Function in statistics between students who were taught using Moore Learning Approach and students taught using Conventional Learning Approach. This means that there was a significant difference between the mean scores of the control group (mean of 33.8) and experimental group (mean of 58.95). These results suggested that Moore Method of Learning has the capacity to improve students' academic performance.

4. Discussion of Findings

4.1 Effects of Moore Learning Approach on Students' Performance in Gamma and Beta Functions

The analysis in Table 3.3 above shows that students who were taught using Moore method of learning performed better than those who were taught using conventional learning approach. These results are in line with Edythe (2005) who concluded that the Moore Method of Teaching fosters much closer instructor attention to the work of each individual student. Students with low academic self-concept profited more from Moore Method of Learning than from direct instruction because they experience a feeling of greater competence. Douglas (2012) conducted a study with the title: Enhanced-Group Moore Method: Effects on van Hiele Levels of Geometric Understanding, Proof-Construction Performance and Beliefs. The analysed results showed that there was a significant difference in the van Hiele levels and proof-construction performance of the future mathematics teachers before and after the study. In addition, there was a significant relationship between the proof-construction performance and van Hiele levels of the future teachers, and there was no noteworthy changes occurred in their beliefs about proofs. Qualitative assessments further showed that the Enhanced-Group Moore Method created self-confidence in the future teachers, encouraged effective communication and facilitated exchange of ideas towards a common goal.

These findings also corresponded with the constructivist learning theory in which learners are in control of constructing their own meaningful knowledge (Vygotsky, 1978). From such a constructivist perspective, students improved their achievement because they were active agents in constructing their own knowledge. Vygotsky's sociocultural theory of human learning describes learning as a social process and the origination of human intelligence in society or culture (Vygotsky, 1978). The major theme of Vygotsky's theoretical framework is that social interaction plays a fundamental role in the development of cognition. Based on the findings of the study, there is enough evidence that Moore learning approach has positive effect on the academic performance of students. The reason for the increase in students' achievement could be caused by the student's involvement in explaining and receiving explanation in which the concepts can be easily understood. According to Edythe (2005), The Moore Method stresses building and reinforcing the student's ego. Moore learning approach gives more space and opportunities for students to discuss, solve problems, create solutions, provide ideas and help each other.

4.3 Conclusion

Results show that there was a statistical difference in performance between the experimental group taught Gamma and Beta Function using the Moore Method of Teaching and that of the control group taught using Conventional Method of Learning. Therefore, the study found that Moore Learning Approach has a positive effect on the students' performance as compared to the Conventional Learning Approach. These results would imply that incorporating Moore Learning Approach in the Mathematics classroom would enhance the learning of mathematics at Mukuba University. The lecture teaching method had been proved to be ineffective in enhancing students' achievement in statistics at Mukuba University.

4.4 Recommendations

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

Moore Learning Approach to be integrated with traditional teaching method in the teaching of statistics. The findings

from this study have proved the effectiveness of Moore Learning Approach in improving the academic performance of students in statistics. Therefore, lecturers are encouraged to use Moore Learning Approach as a way of improving their students' achievement in mathematics. The study also recommended that during peer teaching students should incorporate Moore 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.

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