

Effect of the 21st Century Skills on the Performance of Students in Linear Transformations: A Case of Mukuba University, Kitwe District, Copperbelt Province, Zambia

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Abstract: - This study was conducted in order to investigate the effect of the 21st Century Skills on the performance of Students in Linear Transformations. The problem of poor performance of Second Year Students in Linear Algebra (MAT260), especially in Linear Transformations at Mukuba University has been a matter of concern. To solve this problem a study was conducted by the Researcher. The study population included all Second Year Students doing Linear Algebra (MAT 260) and pursuing a degree programme at Mukuba University. The study was based on one research question and two hypotheses. The research method used was an Experimental Design. The sample size was 60 Students comprising 43 male and 17 female Students. The Shapiro-wilk test was used because of the small sample size. The two groups were made from a homogeneous class at random. Particularly, 30 Students were assigned to the Experimental Group and 30 Students to the Control group. These two groups were subjected to a Pre-test. The Experimental group was lectured using the 21st Century Skills while the Control group was lectured using Conventional methods. The analysis of data was done with the help of SPSS, considering the mean and standard deviation. Then an Independent sample t-test was conducted at alpha (α) = 0.05 to analyse the results of the Post-test scores. The study showed that there was a statistically significant mean difference in the Post-test scores for Experimental group (Mean = 56.67, standard deviation = 18.26) and the Control group (Mean = 42.67, standard deviation = 19.51), $P = .006$. Therefore, using 21st Century Skills in lecturing Linear Transformations was found to have a positive effect on Students' performance.

Keywords: Linear Transformations, 21st Century Skills, Linear Algebra and Conventional Approaches or Traditional Methods.

I. INTRODUCTION

Being a Lecturer of Mathematics and a former Student of Mukuba University, the Researcher has observed that Linear Algebra (MAT 260) has been and is still posing a number of challenges to the Students who are majoring in Mathematics at Second year. For instance, out of 78 candidates who sat for MAT 260 Examination in the 2014 academic year, only 40 candidates representing 51% passed the course while 38 (49%) failed the course. Out of 102 candidates who sat for MAT 260 Examination in the 2015 academic year only 63 candidates, representing 62% passed

the course while 39 (38%) failed the course which is not good for those majoring in Mathematics as the course is a pre-requisite for (MAT 320) Advanced Calculus and (MAT 350) Mathematical and Applied Statistics which are Third Year courses. A further analysis on Linear Transformations showed that Students have not been performing well on this topic. For instance, out of 54 candidates who attempted questions on Linear Transformations in the 2014 Examination, only 11 candidates got the questions correct representing 20% while 43(80%) candidates failed questions on the topic. In 2015, 38% of the candidates who answered questions on Linear Transformations got the question correct while 62% failed. The 2016 academic year results showed that twenty nine (29) candidates attempted questions on Linear Transformations in an Examination. Seven (7) candidates got the questions correct representing (24%) while 22 (76%) failed questions on Linear Transformations. It has been noted that a number of reasons could be attributed to the poor performance on the topic and one of the reasons could be the continuous use of Conventional lecturing methods. So the proposed study wished to determine whether, the 21st Century Skills could have a positive effect on students' performance on Linear Transformations. In line with Voogt and Robin (2010) the 21st Century Skills are skills that teach students on how to be responsible users of technology, such as: internet, video, print, media and television.

1.1 Research objective

To determine the effect of the 21st Century Skills on the performance of Students in Linear Transformations.

1.2 Research question

Does the 21st Century Skills have a positive effect on the performance of Students in Linear Transformations?

1.3 Hypothesis

Null Hypothesis : There is no statistically significant mean difference in performance in Linear Transformation between Students who are lectured using 21st Century Skills and those lectured by Traditional methods.

Alternative Hypothesis : There is a statistically significant mean difference in performance in Linear Transformation between Students who are lectured using 21st Century Skills and those lectured by Traditional methods.

1.5 Scope of the Study

The research study was conducted at Mukuba University. This research targeted all Second Year Mathematics Students. Data was collected from these Students. The study was investigating the effect of the 21st Century Skills on the Performance of Students in Linear Transformations.

II. RESEARCH METHODOLOGY

2.1 Research Design.

In line with Kothari (2004) a Research design is the conceptual structure within which the research is done. It is a blueprint for the collection, measurements and analysis of data. The design constitutes an outline of what the researcher did from writing the hypothesis and its operational implications to the final analysis of data. In other words, a 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 minimize the variances. This study used Quantitative Research in order to assess the effect of the 21st Century Skills on the performance of Students. Quantitative Research in line with Kombo and Tromp (2004) is a kind of research which relies on the principle of verifiability. In this study quantitative data was obtained from Pre-test and Post-test. This study involved an Experimental research design. It is called an experimental because Students were chosen through simple random sampling methods. Furthermore, this research was called an experiment because its aim was to determine the effect of the independent variable on the dependent variable under study. In this regard, the 21st Century Skills were the independent variable, while Students' performance was considered as the dependent variable. Experimental design was used to determine the effect of the 21st Century Skills on Students' performance in Linear Transformation. Questions in the Pre-test and Post-test were based on Linear Transformations. The Experimental group was lectured using the 21st Century Skills while the Control group was lectured using Conventional Approaches.

2.2 Location of the Study

This study was carried out at Mukuba University in the Copperbelt Province of Zambia, Kitwe District in particular. The University is located 6 Km away from The Main Town Centre along Chingola road.

2.3 Target Population

Target population is the set of units to be studied according to John and Sons (2004). The target population of this study was 60 Students from Mukuba University.

2.4 Sample and Sampling Procedures

The study was done at Mukuba University, then two groups of 30 Students each were randomly chosen from a Class of Second Year Students majoring in Mathematics and a further random assignment was done to determine the Control group and the Experimental group. The Experimental group was lectured using 21st Century Skills while the Control group was lectured using Conventional methods.

2.5 Data Collection Instrument/Techniques/Methods

The dependent variable in this study was performance in Linear Transformation. To assess performance of Students, test questions were prepared and validated by the Researcher. Test questions were used for Pre-test and Post-test but were shuffled before being administered in the Post-test.

2.6 Pre-test measure

The Pre-test was given to the two groups. This test was administered before the intervention was done. This assisted in establishing the homogeneity between the Experimental and Control groups. The Experimental group received treatment in form of the 21st Century Skills while the Control group used the Conventional Approaches. The Students from Mukuba University were randomly assigned to Experimental group and Control group respectively. This was done by lottery method. The Researcher labeled 30 pieces of paper with the number **1** and the other pieces with the number **2** then asked each student to pick one paper at random without replacement. Those that picked a paper labeled **1** were taken to the Experimental group while those who picked a paper labeled **2** automatically became part of the Control group. The Experimental group were lectured using 21st Century Skills.

2.7 Post-test measurements

A Post-test was finally administered to the two groups after the intervention. The results were compared. The comparison was done between the Experimental group and the Control group Post-test scores. This was done in order to determine the group which achieved higher marks than the other. Performance of Students in these tests was the dependent variable while the independent variable was the 21st Century Skills.

2.8 Shapiro-wilk test

Before using a t-test, the data was first tested to determine if it was normally distributed. The normality check was important. If it wasn't checked, interpretations and inferences of results based on the data may be unreliable. There are many techniques that can be used to assess whether a set of data is normally distributed or not. Some known methods used to check for normality by Researchers are Jarque-Bera test, Shapiro-Wilk test, Kolmogorov-Smirnov and D'Agostino test. The Shapiro-Wilk test and Kolmogorov-Smirnov are used in almost similar instances. The Shapiro-Wilk test was chosen as the sample size was small. Kolmogorov-Smirnov test is used for bigger samples while the Shapiro-Wilk test is applied to

smaller samples of say 40 or less. In line with Boyer (2013) the Shapiro-Wilk test for normality is valid only for small number of observations of say 5 and 38. The null hypothesis of this test is that scores should be normally distributed. Moreover, if the P-value is less than the chosen level of significance, then the null hypothesis is not accepted. This would mean that the data isn't normally distributed. Then data analysis was done with the help of SPSS Version 16. Shapiro-Wilk normally test was done for the Control and Experimental group. The output column labeled 'Sig' which is the P-value was checked. If the column showed a number above 0.05, then the data was said to be normally distributed. In other words, the alpha level for two-tailed was set to 0.05. This significance level of 0.05 was used as opposed to 0.01 because, the more stringent a test is, and the most likely it is to find a statistically significant result as outlined by Kumar (2011). For the Shapiro-Wilk test, the closer the "sig" value is to 1, the more likely normal the sample is.

2.9 Independent sample t-tests

In line with IDRE (2014) the independent t-test is used to compare means of same variable between two groups. Independent sample t-test was done on the Pre-test scores for both the Control and Experimental group. This procedure was intended to compare the mean score of both the Control and Experimental groups. The SPSS Version 16 output columns also showed the columns labeled df for degree of freedom and t for t-statistic.

2.10 Conclusion

This Chapter has outlined the methodologies that were used in this research. It has also pointed out the suitable research design and data collection methods. The sole purpose of a research design used in this study was to maximize valid answers to the research question. The main concern of the Chapter was to map out how the research instrument was managed and used.

III. DATA PRESENTATION, ANALYSIS AND INTERPRETATIONS

3.1 Introduction

The Chapter discusses the findings of the research from the Pre-test and the Post-test which were administered to the students in order to find out the effect of the 21st Century Skills on the performance of Students' in Linear Transformation at Mukuba University in Kitwe District of the Copperbelt Province. This chapter presents data analysis and interpretation of empirical findings of this study. The result was presented using tables and each result was preceded by a brief analysis.

Table 3.2: Descriptive Statistics for the Pre-test

Test	Group name	N	Mean	Std. Deviation
Pre-test	Experimental	30	21.17	14.00
	Control	30	20.17	15.89

Table 3.2 shows the descriptive statistics and the difference in the Pre-test mean scores between the Experimental and Control group is 1.0. This very small difference in mean score indicated that the two groups started off at a comparatively same level. The mean for the Experimental group Pre-test scores was 21.17, Standard deviation was 14.00 and the mean for the Control group was 20.17, standard deviation was 15.89. This difference is statistically insignificant showing that the results could not happen by chance.

Table 3.3: Descriptive Statistics for the Post-test

Test	Group name	N	Mean	Std. Deviation
Pre-test	Experimental	30	56.67	18.26
	Control	30	42.67	19.51

Table 3.3 shows the descriptive statistics and the difference in the Pre-test mean scores between the Experimental and Control group is 14.0. This very big difference in mean score indicated that the two groups after treatment differed in abilities. The mean for the Experimental group Post-test scores was 56.67, Standard deviation was 18.26 and the mean for the Control group was 42.67, standard deviation was 19.51. This mean difference is statistically significant.

3.4 The Shapiro-wilk normality test

The assumption which was observed before the t-test was that the data collected was normally distributed. The first step was, therefore, to use the Shapiro-wilk procedure to test for normality. The procedure was carried out to check out that the assumption was not violated. A t-test could only be used effectively if the data under investigation is normally distributed. **Table 3.5** shows the results generated using Statistical Package for the Social Sciences (SPSS) software.

Table 3.5: Shapiro-wilk normality test for Experimental and Control groups

	Shapiro-Wilk		
	Statistic	Df	Sig.
Pretest Score	.899	60	.012
Posttest score	.944	60	.112

In this cases the normality test shows a Shapiro-wilk value of more than 0.05 for the post-test. This indicated that the data is normally distributed and implied that the t-test could be used.

Table 3.6: Independent sample t-test for the Experimental and Control groups for Post-test

Type of test	t-test for Equality of Means						
	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Pre-test equal Variances Assumed	2.87	58	.006	14.00	4.88	4.24	23.76

Table 3.6 presents the independent sample t-test for the Experimental and Control group of Post-test. An independent sample t-test was also used to analyse whether there was a significant difference between the mean scores of the Experimental group and the Control group for the Post-test after administration of the treatment to the Experimental group. There was a statistically significant mean difference in the Post-test scores ($P\text{-value} = 0.006 < \alpha = 0.05, t = 2.87$). This result illustrated that the students in the Experimental group outperformed the Control group. Hence, the 21st Century Skills had a positive effect on the performance of Students in Linear Transformations.

IV. DISCUSSION AND CONCLUSIONS

This study investigated the effect of the 21st Century Skills on the Students' performance in Linear Transformations by Students of Mukuba University of Kitwe District of the Copperbelt Province. Findings of the study have been presented in the preceding Chapter. The findings suggest that there is need to address the challenges that have been identified if the quality of learning and lecturing in Mathematics is to improve. The results indicated that using the 21st Century Skills in lecturing Linear Transformations in Mathematics does have a positive effect on the performance of Students. This Chapter hopes to discuss the findings of the study. The discussion of the findings will focus on how one research question which was addressed. The analysis and general discussion of this Chapter is arranged according to the unit of analysis sometimes referred to as research participants and was framed by the following research question;

- Does the 21st Century Skills have an effect on the performance of Students in Linear Transformations?

4.1 Effects of the 21st Century Skills on the performance of Students in Linear Transformations

The study showed that after running the independent sample t-test for the Experimental and Control group for the Post-test at Mukuba University there was a statistically significant mean difference between the mean scores of the Experimental group and the Control group after administration of the treatment ($P\text{-value} = 0.006 < \alpha = 0.05, t = 2.87$). Furthermore, the results showed that the Experimental group had a mean score of 56.67, standard deviation 18.26 while the Control groups mean score was 42.67, standard deviation 19.51 which gave a mean score difference of 14.0. The comparatively big difference in mean scores indicated that the Experimental group achieved higher than the Control group hence the 21st Century Skills had a positive effect on the performance of Students in Linear Transformations.

4.2 The measures to be undertaken in order to improve lecturing of Linear Transformation

In this section, the focus is on measures to be undertaken in order to improve Students' performance and lecturing by use of the 21st Century Skills by Lecturers as an effective Approach. From the results of the t-test in **Table 3.6** showed

that there was a significance differences in the Post-test. This was an indication that 21st Century Skills should be implemented in Universities and Secondary Schools and be used in other Courses or subjects. Other measures to be undertaken by the School Administrators to improve the performance of Students in their respective Universities should include implementation of the following; Seminars, Conferences, Symposiums, Topical tests and Club activities such as Mathematics Club.

The Control group mean score for the Post-test was ($M = 42.67, SD = 19.51$) and the mean score for the Experimental group was ($M = 56.67, SD = 18.26$). The mean difference was statistically significant, $P < 0.05$.

- The Experimental groups mean score for Pre-test was ($M = 21.17, SD = 14.0$) and the mean score for Control group was ($M = 20.17, SD = 15.89$).
- The mean for the Experimental group Post-test score ($M = 56.67, SD = 18.26$) and the mean for the Control group Post-test score was ($M = 42.67, SD = 19.51$). The difference was statistically significant, $P < 0.05$. These result suggested that lecturing Linear Transformations using the 21st Century Skills in Mathematics did have a positive effect on the achievement of high scores by Students.

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