Effect of Using Demonstration Instruction Approach on the Performance of Mathematics Students in Public Secondary Schools in Rwanda: A Case of Karongi District

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Abstract

The aim of this paper was to determine the effect of Effect of using demonstration instruction approach on the performance of mathematics students in public secondary schools in Rwanda: A case of Karongi District'. The study used descriptive research design. Stratified sampling was used to determine a sample of 6 schools among other public secondary schools in Bwishyura sector in Karongi District. The head teachers of the sampled schools were purposively selected to participate in the study. Simple random sampling technique was further applied to obtain Mathematics teachers and students of senior 4,5 and 6, making 783 target students. The study used a sample of 230 respondents from the sampled schools. The collected data was analyzed using descriptive statistics, correlation, and regression analysis through the statistical package for social science (SPSS) version 21. The data collected were analyzed using multiple linear regression analysis. The result of the regression analysis indicates that demonstration Method, discussion method, cooperative learning method and problem solving have a positive effect on Performance of Mathematics students in public secondary Schools in Karongi District and the relationship is statistically significant (p=>0.05) and the relationship is in line with a priori expectation. Results showed significant positive relationship between demonstration instruction method and the performance of Mathematics students (r = .669, p = .0000). Multiple linear regression analysis showed that all demonstration instruction method contributed to 73% of variation on the performance, hence plays a vital role in performance of Mathematics students in public secondary schools in Karongi District. This study recommended that Mathematics teachers should use the demonstration instruction approach teaching Mathematics since it improves academic achievement.

Keywords: demonstration approach, performance, mathematics, and students

Introduction

Education has been described as a veritable tool for the transfer of knowledge, values, cultures, skills, attitude, among others, from one generation to another. This has contributed immensely in the development of communities and nations through innovation (Eniayeju et al, 2014). However, to achieve this, different types of education are being developed to train professionals such as: engineers, scientists, architect, educationist, lawyers and others, to be able to innovate and manufacture most of the things in the World today. Basically, students at the primary and secondary schools are taught subjects that can prepare them for the task ahead (UNESCO, 2014).

Teaching mathematics in today's world requires practices and procedures integrated with performance tasks that actively involve students. More pupils in secondary schools are still finding it difficult to see mathematics as an easy subject, contrary to what some mathematicians say. In their desire to study science-related subjects and take after their doctor and engineer idols, they have often been discouraged by their inability to understand the intricacies of calculation (Biotenbeck, 2011).

Although student performance depends on different factors, teaching methods have an essential role in the success of mathematics lessons (Omotayo and Adeleke 2017). According to Ganyaupfu (2013), student

academic failure is strongly associated with the use of ineffective teaching methods to convey information to students. In a teaching and learning environment, students' active participation with lessons as well as the use of learning approaches that help students remember what they learn is important dimensions. Effective learning approaches increase the quality of learning. Students learn best by doing and experiencing (Smith, 2014). In a demonstration and discussion learning approach, students and teachers are in a state of dynamic interaction in the classroom. When students interact in cooperative groups they learn to give and receive information, develop new understandings and perspectives, and communicate in a socially acceptable manner.

Karande (2015) highlighted mathematics teaching methods as a major contributor to student performance in Kenya. He added that teacher classroom practices have a strong influence on student performance and interest in mathematics. A study by Mkumbo (2013) associated a low conceptual understanding with poor teaching approaches used by teachers in Rwandan schools. Zalmon and Wonu (2017) linked the failure of students in Nigeria to poor teaching habits in a mathematics classroom for many years. Similarly, the study of Muharam et al. (2019) showed that teachers' teaching approaches significantly affect students' performance.

The influence of the learning environment upon knowledge development has received relatively little attention in the field of mathematics teaching and learning (Samuelsson, 2008). Even so, teachers often expect researchers to provide that kind of knowledge in mathematics didactics. What happens in the classroom has an impact on students' opportunity to learn. The activities in the classroom, the repeated actions in which students and teachers engage as they learn are important because they constitute the knowledge that is produced (Ray, 2001). There is some evidence that different teaching styles can have different impacts on student achievement Thus, the mode of teaching method in mathematics seems to be important for students' development of mathematical proficiency. In the present study, the effectiveness of demonstration method on performance of students in mathematics subject is examined.

This study sought to achieve the following research hypothesis:

H_{O1}: There is no significant effect between demonstration instruction method and performance of Mathematics students in public secondary schools in Karongi District.

2.0. Methodology

This study evaluated the effect of teaching methods on student's performance in mathematics in public secondary schools of Karongi in Rwanda. For this study, the population was formed by public secondary school teachers from 6 public secondary schools offering general education in Karongi District of Rwanda. The study targeted those six schools because they are more affected with a big percentage of enrollment rate of students. Thus, the study targeted students, deans of studies, head teachers and teachers from those six selected schools. Besides, the research targeted secondary school Mathematics teachers since the study was to assess the effect of teaching methods on performance of Mathematics in public secondary schools in Karongi District. Science/Mathematics students of senior 4,5 and 6 was targeted because they have better knowledge and experience about their schools' teaching and learning methods compared to other students in their respective schools

Table 1: Table showing size of population of selected schools

Schools	Number of teachers	Number of Dean of studies	Number of head teacher	Number of Students	Total population
ES Bwishyura	4	1	1	138	144
GS Nyegabo	3	1	1	121	126
GS Kibuye	5	1	1	98	105
GS Nyamarebe	6	1	1	162	170
GS Nyabikenke	2	1	1	139	142
GS Rurangwe	2	1	1	125	129
Total	22	6	6	783	**817**

Source: Karongi district report, 2022

In this study, stratified, purposive sampling and simple random sampling techniques was used. Stratified sampling was used to determine a sample of 6 schools among other public secondary schools. It was done to make sure all schools in the district was represented in the study. Schools was stratified or grouped then one school will be selected randomly. The head teachers of the sampled schools were purposively selected to participate in the study. Simple random sampling technique was further applied to obtain Mathematics teachers and students of senior 4,5 and 6, making 783 students from the sampled school.

In addition, the study used the following formula proposed by using Yamane (1973) to determine the sample size because that is too large waste scarce resources and could expose more participants than necessary to any related risk. Thus, the study used Yamane formula to calculate a sample size because it is the most appropriate for this study.

Using Yamane formulae

$$n = \frac{N}{1 + (N)(e^2)}$$

Where:
n = sample size
N = the population size
e = the acceptable sampling error (5%) at 95% confidence level
Thus; n = 817/ (1+817) (0.05)^2
        n=272.3=272 respondents

A sample of 272 respondents was targeted to participate in this study. This formula was used to estimate a representative sample. A total number of 272 respondents was taken as simple size. The following is the table showing sample size for each category of five selected schools:

Table 2. Table representing a sample size

Schools	Number of teachers (Mathematics)	Number of Dean of studies	Number of head teacher	Number of Students	Sample size
ES Bwishyura	2	1	1	44	48
GS Nyegabo	1	1	1	40	43
GS Kibuye	2	1	1	30	34
GS Nyamarebe	3	1	1	53	58
GS Nyabikenke	1	1	1	44	47
GS Rurangwe	1	1	1	39	42
Total	10	6	6	250	**272**

Source: Researcher, 2023

In this study the researcher used interviews, questionnaires, and documentary review. Closed –ended questions were used where the answers were divided into categories such discrete, distinct and relatively few in number. It is easier for respondents to answer because they had only to choose categories. In that way a chance for irrelevant answers is limited to the minimum, because appropriate answer categories were provided. The main respondents were being teachers that was given the questionnaire as they were enough time to respond to the questions based on specific objectives. Questionnaires were given to Mathematics teachers, dean of studies and students from senior 4, 5 and 6.

The study involved oral questions based on the use of interview guides. This was a flexible way, because questions were both open and closed ended. This method helped the interviewer to collect supplementary

information about the respondents as well as the researcher probed for more specific answers while at the same time helping the researcher to repeat a question when the response indicated that the respondent misunderstands the question

Interview guides were used to head teachers. The respondents were requested to answer questions, and the researcher used semi-structure interview questions which enabled the researcher to ask broad questions in any order considered appropriate. Also, questions gave the respondents room to answer freely and amplify the responses. The respondents were interviewed at their perspective school.

3.0 Findings and discussion
3.1. Findings
In this study the research sampled Mathematics teachers, headteachers, and science/Mathematics students of senior 4,5 and 6 because they have better knowledge and experience about their schools' teaching and learning practices compared to other students in their respective schools. Table 3 shows the return rate of respondents.

Table 3. Response rate

Respondents	Targeted	Obtained	Response rate(%)
Head teachers	6	6	100
Teachers of Mathematics	16	12	75
Students	250	212	84.4
Total	**272**	230	84.5

Source: Primary data, 2023

As shown in Table 3, from the targeted respondents, four questionnaires from teachers and 38 questionnaires from students were not returned, so the participation rate was reduced to 12 (75%) of the teachers and 212 (84.4%) of the students. Regarding headteachers, the study sampled 6 school headteachers from 6 secondary schools and 6 of them interviewed; therefore, the response rate was 100%. Overall, the response rate of respondents was 84.5%.

3.1.1 Descriptive Statistics
Effect of demonstration instruction method on the performance of mathematics students in public secondary schools in Karongi District.

In this research the study attempted to determine the effect of discussion method on academic performance of mathematics subject in public day schools in Karongi District in Rwanda.

Table 4: Level of agreement on how demonstration instruction method and performance of Mathematics students

Statements	Mean	Std Dev
The method should be carried out in a simple and easy manner class	4.6	.77
In this strategy, full attention should be paid to all the students in the class while learning Mathematics	4.1	.82
Goals and objectives of the demonstration should be very clear	4.1	.72
Demonstration method should be carried out with a well-planned strategy	4.2	.50
In a set time should be dedicated to the rehearsal before the demonstration	4.4	.90
This method develops an interest in the learners and fosters active engagement from them	4.0	.67
Any complex topic can be easily explained with this method	3.8	.72

Source*: Primary data, 2023

As shown in Table 4, the results relate to the six statements assessing the effect of demonstration method on the performance of Mathematics students in public secondary schools in Karongi District. The results show that for the first statement, the majority of respondents strongly agreed that the demonstration should be carried out in a simple and easy manner class while learning Mathematics subject, with a mean value of 4.6, and a high positive correlation standard deviation of 0.77. The second question asked respondents whether in this strategy, full attention should be paid to all the students in the class while learning Mathematics. The results showed that the majority of respondents strongly agreed with this statement (M=4.1, SD=0.82). For the third statement, goals and objectives of the demonstration should be very clear while learning mathematics subject ', the majority of respondents agreed with this statement, with a mean of 4.1 and a very positive and low standard deviation correlation (0.72). The fourth statement asked whether demonstration method should be carried out with a well-planned strategy while learning mathematics. Respondents strongly agreed with this statement, with an average mean of 4.2 and a very strong positive standard correlation of 0.50. The next question on a set time should be dedicated to the rehearsal before the demonstration. The majority of respondents agreed with this statement, with a mean of 4.4 and a strong correlation standard deviation of 0.90. The next item was whether this method develops an interest in the learners and fosters active engagement from them. The majority of them strongly agreed that statement with a mean of 4.0 and standard deviation of 0.67. On the last statement respondents were asked if any complex topic can be easily explained with this method, more than a half of the respondents agreed that statement (M=3.8, SD=0.72). From the results, it implies that the majority of respondents strongly agreed and agreed that all of the above are key elements of demonstration method used in their six selected schools and have an effect on students learning outcomes in Mathematics subject

From the findings, the study found that demonstration method affects performance of Mathematics students, when the demonstration should be carried out in a simple and easy manner, as in this strategy, full attention should be paid to all the students in the class, goals and objectives of the demonstration should be very clear, as it should be carried out with a well-planned strategy, as a set time should be dedicated to the rehearsal before the demonstration, as this method develops an interest in the learners and fosters active engagement from them and as by using this method complex topic in Mathematics can be easily explained with this method

The interview data gathered the views of the participants on the effect of demonstration method on the performance of the students in Mathematics subject in Karongi District.

There were interviewed Sector Education officers and head teachers, the findings from the interview given to them about demonstration method and performance of Mathematics students showed that all respondents unanimously agree that there is a strong correlation between demonstration method and the performance of students in the Mathematics subject.

One of them expressing his views, a headteacher had this to say:

> *"The demonstration teaching method involves stimulating and student-centered activities which could improve students' academic achievement in Mathematics better than teacher-centered methods. In order words, the use of action-inspiring and student-centered teaching methods such as demonstration methods progresses students' academic achievement. Yet most teachers at senior secondary schools still use conventional teaching method which is teacher-centered "(24th November, 2023).*

These findings are in agreement with Tabulawa (2016) who stated that through demonstrations, students are exposed to physical materials that will illustrate some meaning to their cognitive context. Experiences like this go a long way to enriching learning. The demonstration method bridges the gap between theory and practice, enables learners to become good observers and generate their interest; students see immediate progress as a result of a correct effort, and enables the teacher to teach operational skills.

3.1.2. Correlation analysis
In this section, Pearson's correlation is employed to examine the relationship between the independent variables (IVs) and the dependent variable (DV). To test the relationship, in this section, the mediator in this

study is treated as a dependent variable. The findings of the correlations between the independent variables and the dependent variables are summarized and presented in Table 4

Table 4: Correlation Analysis between independent and dependent variable

		Discussion Method	Performance of Mathematics students
Demonstration instruction approach	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	230	
Performance of Mathematics students	Pearson Correlation	.669**	1
	Sig. (2-tailed)	.000	
	N	230	230
**. Correlation is significant at the 0.01 level (2-tailed).			

According to the findings reported in Table 4, the Pearson correlation analysis showed that demonstration instruction approach (r=0.669, p=0.000) is positively and significantly related to performance of Mathematics students in public secondary Schools in Karongi District. The correlation was deemed to be statistically significant since the p-value was less than 5%.

These findings are supported by McCabe (2014) who stated that that there is a high positive relationship between student's performance and teaching methods especially demonstration method. The demonstration teaching method involves stimulating and student-centered activities which could improve students' academic achievement in Mathematics better than teacher-centered methods. In order words, the use of action-inspiring and student-centered teaching methods such as demonstration methods progresses students' academic achievement. Yet most teachers at senior secondary schools still use conventional teaching method which is teacher-centered.

3.1.3. Multiple Regression
A multiple regression analysis was performed in this section to identify the predictor and its contribution towards the criterion. The study would like to test the hypothesis:

Table 5. Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.855[a]	.731	.727	.56311
a. Predictors: (Constant), demonstration instruction approach				

The Table 5 below shows the quantity of variance that is explained by the predictor variable. The first statistic, R is the multiple correlation coefficient between the predictor variable and dependent variable. In is model, the value is .855[a], which indicates that there is a great deal of variance shared by the independent variables and dependent variables. The next value, R Square, is simply the squared value of R. This is frequently used to describe the goodness of fit or the amount variance explained by a given set of predictor variables and its value is 73 % of the variance in the dependent variable is explained by independent variables in the model.

Table 6. Significance of Independent variable

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	62.518	4	15.630	66.250	.000[b]
	Residual	29.490	125	.036		
	Total	92.008	129			
a. Dependent Variable: performance of mathematics students						
b. Predictors: (Constant), demonstration instruction approach						

The Table 6 above indicated standard regression which provides the effect of individual predictor variables. That variables are demonstration method, discussion method, cooperative learning method, and problem solving method. The table shows the output analysis and whether there is a statistically significant difference group mean. As seen, it, the significance value is 0.00^b and the mean square is 15.630 which is above 0.05. Therefore, there is a statistically significant difference in the mean length of model.

Table 7. Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.479	.313		4.732	.000
	Demonstration instruction approach	-.221	.038	-.371	-5.845	.000
a. Dependent Variable: Performance of Mathematics students						

Information presented in Table 7 evidenced that $Y=1.479-0.221X_1+\varepsilon$ Where y=project performance. The regression output above shows that demonstration instruction method, are statistically equal to 0. 000.This shows the regression of independent variables are associated with project performance. Multiple analysis regression result above indicates the effect of independent variables based on the regression coefficient. The unstandardized Coefficients is 1.479 when is constant and at the same time the Std. Error is 0.313 when they are associated with coefficients. The significant predictor is positively related to the criterion in the regression, as shown in Table 4.7.

This study sought to achieve the following research hypothesis:

H$_{O1}$: There is no significant effect between demonstration instruction approach and performance of Mathematics students in public secondary schools in Karongi District.

Therefore, the researcher can conclude by saying that the research hypotheses all were tested; verified and then they are rejected referring to the statistical (regression analysis) findings and then according to the research, the correlation of 73% categorized as positive and very high correlation; this leads to confirm that there is significant relationship between accounting automation and performance of financial institutions.

4.0 Conclusion

Based on the findings of this study, it was concluded that teaching method affects students' academic performance in those six selected schools in Karongi District as the teaching method, which is used by teachers in Mathematics, predicts the student performance compared to other factors. The secondary school students have continued to perform poorly in Mathematics, which may be the influence of teaching methods.

In light of the conclusions drawn, the researcher recommended among others that efforts should be made by teachers in thoroughly integrating demonstration instruction approach in their teaching. Also, Mathematics teachers should ensure the active hands-on participation of students during mathematics classroom instruction and Mathematics teachers should use the demonstration instruction approach teaching Mathematics since it improves academic achievement.

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