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Effects of Classroom Seating Arrangement on the Academic Performance in Mathematics of Students in Public Day Schools in Musanze District, Rwanda

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Abstract: *The study aimed to investigate the impact of classroom seating arrangements on the academic performance of students in the subject of Mathematics in public day schools in Rwanda, focusing on Musanze district. The study employed a descriptive research design, utilizing a mixed methods approach that incorporates both quantitative and qualitative research methods. The target population consisted of educational practitioners in the district, including students, teachers, head teachers, and the Sector Education officer, with a total population of 1600 participants. A sample size of 320 respondents was selected using a simple random technique. The quantitative data underwent analysis through descriptive statistics, while qualitative data was subjected to content analysis. Statistical tools such as the Statistical Packages for Social Science (SPSS) version 21 were employed for data analysis, and the results were presented in the form of pie charts and tables using Microsoft Word. The findings from the study indicated a positive and significant correlation (r=0.775, p=0.000) between classroom seating arrangements and students' academic performance in Mathematics in public day secondary schools in Musanze District, as revealed through Pearson correlation analysis. In conclusion, the study suggests that teachers should consider rotating students regularly. Providing students with opportunities to sit up front, even briefly, has the potential to improve grades and increase interaction with teachers, ultimately enhancing intrinsic motivation. It is emphasized that this motivation could be fostered throughout the entire classroom, freeing students from the requirement of sitting in the front to achieve academic success.*

Keywords: *Seating, Arrangement, Students, Academic performance, Mathematics*

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1. Introduction

A student's academic journey extends beyond examinations, tests, and assignments; it is also shaped by various environmental elements. The design of the classroom is one such element. Depending on the policies of the school district and the latitude granted to them, teachers can significantly influence students through minor adjustments. For instance, if a teacher aims for a serene and soothing classroom atmosphere, they can strategically utilize colors to achieve this effect.

Classroom design can be varied in many ways to encourage classroom discussion (Marx et al., 1992). In traditional classrooms, participation is lower at the back of the class, grades decrease as the distance from the teacher increases, and in larger classes a lower percentage of students participate. In contrast, semi-circular arrangements allow for more relaxed discussions both between teachers and students and among students themselves. Students also asked more questions and learnt more than in traditional rows and columns. These decentralised arrangements encourage participation and show that the physical characteristics of the classroom significantly influence student engagement (Ridling, 1994).

It has been proposed that students' performance in the classroom may be linked to the alignment of their individual learning styles with the teaching style employed in the classroom. A mismatch between these styles is associated with undesirable behavior and subpar academic performance (Baum, Renzulli, and Hebert, 1995). This suggests that modifications to the environment could mitigate some misbehavior and enhance student performance in the classroom. Numerous studies indicate that students positioned at the front of the class tend to outperform those seated elsewhere, irrespective of individual preferences. Even students who initially prefer back seats exhibit significant performance improvement when moved to the front (Spicer, 2016). The belief is that the front of the classroom offers fewer distractions, allowing students to concentrate more on the teacher. This research underscores that a student's success in the classroom is not solely determined by their inherent learning abilities; instead, the environment in which a student is placed plays a role in their success or failure in a particular subject.

The physical arrangement of most classrooms provides insights into the learning process, from lecture halls to smaller, more personalized classrooms, all sharing a relatively similar appearance. It's easy to envision students entering, taking their seats, opening their notebooks, and sitting quietly while the teacher occupies the lectern or moves to the front of the class. Sanders (2018) discovered that teachers and administrators often adhere to traditional furniture arrangements. Even when portable chairs are used, deviations from the established rows are infrequent. The adherence to flat rows almost inevitably labels deviations as subversive (Becker, 2013). Likewise, when Rolfe (2011) compared classroom participation in rooms with fixed and movable seating, he observed that while movable seating was more convenient for teaching, it was less effective in terms of teaching and patterns of space use, which remained largely unchanged.

2. Literature Review

While there is general agreement that different placement options are effective, there is considerable disagreement about how and when to best use different placement options to meet students' needs. There is still much confusion about the relationship between placement options and students' academic performance in the classroom. Kinahan (2017) noted that teachers are not fully aware of how students benefit academically from different placements in the classroom.

In relation to the above statement, the physical environment of the classroom should be considered an important factor in providing students with an optimal learning experience (Fernandes et al., 2015). Nevertheless, decisions have to be made on how to implement different seating arrangements in the classroom and how these arrangements will fit into the daily routine of the classroom (Cillessen, 2015). This is because each seating arrangement has a direct impact on how students acquire knowledge and indirectly affects their learning outcomes. Over the past three decades, several researchers have tried to understand how classroom seating affects students' learning outcomes (Woodson, 2015).

When you think about the importance of the school environment, you might think about how students feel in the classroom and what the classroom looks like physically. Numerous studies show that there are a number of additional factors that come into play when talking about 'school environment'. When Weinstein (2019) examined the different components of the school environment, he focused on aspects such as "seating position, classroom design, density, privacy, noise and windows" and classroom ecology (p. 578). Several decades ago, Weinstein had already managed to establish a link between students' seating position in the classroom and their academic performance. In a study conducted 17 years later, a sense of belonging was found to be positively correlated with student achievement and effectiveness due to the positive relationships between students and teachers and their ability to promote school enjoyment without fear of failure (Midgley, 2016). As discussed in recent research by Fernandes, Huang and Rinaldo (2011), results showed that effective classroom seating design influences student participation, sense of control, and academic and non-academic activities.

Research shows that the front of the classroom is the best place to perform. But the problem is a bit more complex. Placement at the front of the classroom is determined by the number of students, so in many cases, it's the size of the classroom that causes problems. Classroom size has been shown to have a direct effect on the number of students participating smaller classes (6-20 students) had almost twice as many students as medium (21-50) and large (50+)

classes. The small classes had an average of 5.8 minutes of student participation, while the medium and large classes had 2.4 and 2.6 minutes of student participation respectively (Becker, 1973). Higher student participation is naturally in line with better student performance, as more communication allows the teacher to solve problems that arise, better understand where students are having difficulties, and to keep students' energy and motivation high.

The purpose of this paper was to analyze the effect of classroom seating arrangement on academic performance of students in public day schools in Musanze District.

This study sought to achieve the following research hypothesis:

H_{o1}: There is no significant relationship between classroom seating arrangement and academic performance of students in Mathematics in public day schools in Musanze District.

3. Methodology

Research design serves as a systematic framework for study procedures. This research employed both qualitative and quantitative methods to investigate the causes, effects, and relationships between variables. Using a survey research design, data from students, teachers, head teachers and Sector Education officers from five public day schools from Musanze sector which are GS Muhoza I, GS Muhoza II, GS Kabaya, GS Cyabagarura and GS Busogo I. Thus the total population was 1600 Participants. The table below gives details of the target population.

Table 1: Table showing size of population of selected schools

Schools	Number of teachers	Sector Education officers	Number of head teacher	Number of Students	Total population
GS Muhoza I	10	-	1	338	354
GS Muhoza II	11	-	1	321	332
GS Kabaya	11	-	1	398	415
GS Cyabagarura	11	-	1	390	408
GS Busogo I	7	-	1	347	411
Total	50	5	5	1540	**1600**

Source: Musanze District report, 2023

Random sampling was used to select a representative sample of each of the parties used in the study. This study consists of 1,600 persons as the research population and the sample size was determined using Yamane's (1973) formula,

Where:
n is the sample size,
N is the population size, and
e is the marginal error of 5% through level of confidence of 95%.
Thus, this formula is applied to the above sample
$n = \frac{N}{1+N(e)^2}$ Therefore, $n = \frac{1600}{1+1600(0.05)^2} =$ 320
N: Total population under the study was 1600 and n: sample is 320

A carefully constructed questionnaire and a written interview guide were used to collect written and oral responses from key informants, including pupils, school principals, education staff and teachers.

4. Results and Discussion

Mathematic teachers, headteachers, and 4^{th}, 5^{th} and $_6{}^{th}$ grade science/Mathematics students were selected for this study because they have more knowledge and experience of teaching and learning in their schools than other students in their schools. The study involved 250 questionnaire respondents and 5 headteachers from 5 selected secondary schools were interviewed.

4.1. Results

4.1.1. Descriptive Statistics

Effect of classroom seating arrangement on academic performance of mathematics subject

In this research the study attempted to determine the effect of classroom seating arrangement on academic

performance of mathematics subject in public day schools in Rwanda.

Table 2: Respondents' perceptions on how classroom seating arrangement affect academic performance of mathematics subject

Statements	Mean	Std Dev
The seating arrangement when teaching Mathematics as subject facilitates the teacher's assistance during class.	3.82	1.04
The seating arrangement when teaching Mathematics facilitates class related interaction among the students during class.	4.26	.63
The seating arrangement when teaching Mathematics allows for ease of movement.	3.90	.75
Classroom seating arrangements when teaching Mathematics affect student engagement in class activities through the level of convenience of communication and interaction.	4.35	.72
In my class I can see every student in the class when teaching Mathematics	4.50	.75

D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree, M=Mean, Std=Standard deviation

As shown in Table 2, the results refer to five statements assessing the impact of classroom seating arrangements on students' achievement in mathematics. The results show that seating arrangements in the mathematics classroom significantly facilitate the teacher's assistance in the classroom, with a mean score of 3.82 and a very high positive standard deviation of 1.04. This determined a high standard deviation in the perception of the respondents. This resulted in a high standard deviation in the perception of the respondents. The second question asked respondents to what extent they agreed that sitting in mathematics lessons promotes student interaction in the classroom. In this instance, respondents expressed disagreement, with a mean of 4.26 and a positive correlation standard deviation of 0.63, signifying that the majority of respondents did not support this statement. Moving on to the next aspect, which assessed whether the seating arrangement during mathematics instruction allows for ease of movement, most respondents strongly disagreed, yielding a mean of 3.90 and a high positive correlation standard deviation of 0.75. Regarding the fourth query about whether classroom seating arrangements during mathematics instruction impact student engagement in class activities through the convenience of communication and interaction, respondents strongly concurred, registering a mean of 4.35 and a positive high correlation standard deviation of 0.72. Lastly, respondents were asked if they can see every student in the class during mathematics lessons. On this point, respondents strongly disagreed with a mean of 4.00 and a very high correlation standard deviation of 1.16, indicating substantial divergence in the perceptions of the respondents. Consequently, the majority of respondents were in disagreement and shared the perspective that the aforementioned aspects are not pivotal components of classroom seating arrangements and do not influence students' academic performance in the sampled schools.

Table 3: Level of agreement on students' academic performance

Statements	Mean	Std Dev
The registration rate for the pupils was outstanding.	3.71	0.94
The students' academic result in national exams are generally excellent	3.69	0.95
The dropout rate of students was decreasing	3.88	0.51
The repetition rate of students has decreased.	4.16	0.88
I will evaluate the overall job performance of the school.	3.97	0.72

Source: Primary data, 2023

D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree, M=Mean, Std=Standard deviation

From Table 3 the level of agreement of students' academic performance in Mathematics as subject was revealed. As shown, respondents reported that the registration rate for the students was outstanding., with a mean of 3.71 and a standard deviation of a very positive correlation of 0.94. In addition, respondents also strongly indicated that the students' academic result in national exams are generally excellent, with a mean of 3.69 and a standard deviation of a very positive correlation of 0.95. The third question asked whether the dropout rate of students was decreasing. Most of respondents agreed with this statement, with a mean of 3.88 and a standard deviation of 0.51. The next item asked whether the repetition rate of students has decreased and, for this statement, the majority of the respondents agreed with a mean of 4.16 and a standard deviation of the very high positive correlation of 0.88. This mean indicates that the majority of respondents agreed, but with a large difference of opinion. Lastly, respondents were asked whether they evaluated the overall job performance of the school, the majority of respondents agreed that statement with a mean of 3.97 and a standard deviation of 0.72

4.1.2. Inferential Statistics

Table 4: Correlation Analysis between classroom seating arrangement and students' academic performance in Mathematics

		Classroom seating arrangement	Students' academic performance
Classroom seating arrangement	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	250	
Students' academic performance	Pearson Correlation	.775**	1
	Sig. (2-tailed)	.000	
	N	250	250

**. Correlation is significant at the 0.01 level (2-tailed).

The results of Pearson correlation analysis in Table 4 show that classroom seating arrangement (r=0.775, p=0.000) is positively and significantly related to students' academic achievement. Since the p-value was less than 5%, the correlation was considered statistically significant.

Thus, the results of the correlation analysis indicate that there is a positive and statistically significant relationship between classroom seating arrangement and students' performance in mathematics in the five selected government schools in Musanze district. Classroom seating arrangement is an important factor that determines students' academic performance. A study by Benedict and Hoag (2014) shows that pupils who sit close to the blackboard perform better in mathematics than those who sit far from the blackboard.

4.1.3. Multiple Regression

The results of the multiple regression are presented in the tables that follow.

Table 5: Fit of model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.807[a]	.651	.642	.89127

a. Predictors: (Constant), Classroom seating arrangement

The table above indicates the fit of model. It shows the fitness of the regression model in explaining the variables under study. The findings show that the predictor variable; Classroom seating arrangement adequately explained students 'academic performance. R square of 0.651 supported the findings. This implies that the predictor variables can explain 65.1% of the students 'academic performance which implies that 34.9% of

decision making can be explained by other factors not captured by this study.

Table 6. Analysis of variance

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	168.764	3	56.255	70.817	.000[b]
	Residual	90.558	114	.794		
	Total	259.322	117			

a. Dependent variable: students 'academic performance

b. Predictors: (constant), classroom seating arrangement

The ANOVA statistics in Table 6 show that the overall model is statistically significant. This is confirmed by a probability value (p) of 0.000. The results of the F-test at the 0.01 level of significance are: F-estimation>table, F-estimation=70.817 and P ,000b and <0.05. The model is therefore significant at the 1% significance level. The p-value reported in this study is significant because it is less than the normal probability at the 0.05 level of significance. These results indicate that the independent variable 'student performance in mathematics' is a good predictor of student performance in mathematics.

4.2. Discussion

From the findings, the study revealed that classroom seating arrangement affects academic performance of mathematics subject, by the seating arrangement when teaching Mathematics as subject facilitates the teacher's assistance during class, by the seating arrangement when teaching Mathematics facilitates class related interaction among the students during class, by the seating arrangement when teaching Mathematics allows for ease of movement and by classroom seating arrangements when teaching Mathematics affect student engagement in class activities through the level of convenience of communication and interaction.

The interview data gathered the views of the participants on the effect of classroom seating arrangement on the academic performance of the students.

The Sector Education officers and head teachers were interviewed and the findings from the interview given to them about classroom seating arrangement and academic performance in Mathematics subject showed that all respondents unanimously agree that there is a strong correlation between classroom seating arrangement and their academic performance in the mathematics subject.

One headteacher expressing his views had this to say:

> *"Some students prefer to sit near doors and windows because it provides enough entertainment to avoid monotonous lessons. Joking, whispering, passing notes, doodling, etc. are common among pupils who usually sit at the back. As a result, seating arrangements can be a cause of poor pupil performance because attention, concentration, comprehension and ability to absorb information may depend on where pupils choose to sit. "(10th October,2003).*

These results are in line with the study by Rachel (2013), which found that in most cases desks were compared with sets of tables (i.e. clusters, tables or groups), here collectively referred to as "clusters". In two studies, desks were also compared with circular arrangements (Hartig, 2010). All but two studies (Bennett & Blundell, 1983; Marx, Furher, & Hartig, 2000) were interested in identifying changes in on-task performance behaviour as a result of imposed seating arrangements, although definitions of "on-task performance" varied considerably between studies.

The findings imply that students 'academic performance is affected by classroom seating arrangement the registration rate for the pupils was outstanding, when there is he students' academic result in national exams which are generally excellent, when the dropout rate of students was decreasing, when the repetition rate of students has decreased and finally when they evaluate the overall job performance of the school.

5. Conclusion and Recommendations

5.1 Conclusion

From the findings of this study, it is concluded that classroom seating arrangement affects academic performance of mathematics subject by the seating arrangement when teaching Mathematics as subject facilitates the teacher's assistance during class, by the

seating arrangement when teaching Mathematics facilitates class related interaction among the students during class, by the seating arrangement when teaching Mathematics allows for ease of movement and by classroom seating arrangements when teaching Mathematics affect student engagement in class activities through the level of convenience of communication and interaction.

5.2 Recommendations

In light of the conclusions drawn, the study recommends that it has been demonstrated through research and experimentation that moving students to the front and center of a classroom gives them the potential for higher performance on assessments that test newly learned material. This information can help teachers design classroom seating plans that maximize student potential and minimize student distraction while studying Mathematics. Besides, the teachers should rotate students frequently. By bringing students up front, even for a short time, the student has the potential for higher grades and more teacher interaction, therefore helping to increase intrinsic motivation. This motivation could be brought to other parts of the classroom, so the student is not required to sit in the front in order to do well.

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