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# The Effect of Geographical Location of Schools to the Learners' Mathematics Performance: A Quasi-Experiment of Senior Secondary Schools in the Buffalo City Metro Education District

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**Abstract**
*There is an ongoing concern of rural versus township versus uptown learners achieving different levels of academic success. For this regard, a quasi-experiment was carried out on three Senior Secondary School classes in the Buffalo City Metro education district. A quantitative approach, pretest~post-test on mathematical achievement design was adopted. To analyse data, a two-way ANOVA was run on a sample of 297 participants to examine the effects of teaching strategy (traditional versus cooperative) and the location of schools (uptown vs township vs rural) on learner performance (scores). The findings revealed that there was significant interaction between the effects of teaching strategy and the location of school on learners' performance,* $F_{(2,291)} = 5.31, p = .0054$. *cooperative teaching strategy learners perform significantly better (average 20.98;* $t = 38.20$; $p =.000$) *than traditionally taught ones (mean = 11.05;* $t = 22.65$; $p = .002$). *It was also observed that uptown learners under cooperative teaching strategy perform the best, while rural learners taught in the traditional way perform the worst. Sample main effects analysis showed that learners from uptown performance is highest, followed by township and lastly, rural learners. For a close comparison of the three locations, a Scheffe Post-Hoc mean comparison technique was used and the differences were statistically significant, at least at 5%, except for township vs uptown, which is significant at 10%. The greatest difference is between rural vs uptown.*
***Key Word****: Academic performance, school location, teaching strategy, Analysis of Variance, Scheffe Post-hoc analysis*

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## I. INTRODUCTION

It is important that a research be conducted to ascertain how school location affect learners' mathematical performance. For an example, a research by Meiring, Kennemeyer and Potgieter (2018) highlighted that for those who have attended the public schools, at most 4% of those are to be expected to receive a university admission from which the majority of the learners having attended in the inner-city schools. However, this study describes the factors surrounding a school according to learner enrolment; location of the school and its quintile in terms of resources. The school location has three categorisation: 1) uptown school, 2) township school, and 3) rural school. A dummy recording of the location of the school generated three of the variables in addition to uptown classes for a baseline type category through which township and rural schools' comparison were juxtaposed. The location of the school was used to describe a school's resources' background (see Ma & Bradley, 2004).

As a result of differences in terms of school locations in the Buffalo City Metro education district, there is a need to further study the effect of school location on learners' Mathematical performance. Alalade (2019) indicated that school location is crucial in the determination of academic performance. He further substantiated that some of the factors that may make learners in the urban locality to be more competent in comparison with those schooling within the rural locations, are social in addition to infrastructural amenities: good roads, information computer technology (ICT), social media devices, and a conducive environment. While their counterpart schools in rural locations are at a disadvantage of those resources such as libraries, electricity supply and ICT. Those in the urban centres have these resources in place that contribute to effective teaching and learning. Part of the effort of this study to improve learner performance involves the discernment of specific disparities like school locations (uptown versus township versus rural) that may have some contributions to the performance gap in substantial different ways. School location as one other variable that can influence learner performance in Mathematics. Past studies have delved into the effect that school location might have on learner's performance, achievement, knowledge, attitude, etcetera, whether in the sciences, arts or humanities.

In accordance with Curriculum Assessment Policy Statement [henceforth, CAPS] document, Mathematics learning in South Africa [henceforth, SA] should change for the better as it requires higher levels of understanding which are far more than mere memorisation of definitions, concepts, formulas and operations with the aim of applying these to Maths problems and exercises which do not relate to real life (National Department of Education [NDE], 2012). Inadvertently, the subject of Mathematics comprised the unplanned effects to numerous candidates determined to apply to institutions of higher learning, according to SAQA (2001). It is regardless of "the arguments for the need to produce numerate citizens who can, at worst, 'get by' in banks, shops, and casinos" (p.19). However, specific leading concern among stakeholders in SA is a non-improvement of learners' Mathematics performance. The present study is set out to explain variables effecting learner performance within the context of mathematical experiment by addressing its relevance in respect to school locations. Mathematics is taught as a separate subject without necessarily talking about worldly issues. Teachers are the instruments to implement knowledge and code of conduct are enforced. The other side of the hidden curriculum (of the General Education and Training [GET] band), accepted conduct for university life or professional world of work to the learners is specified. In addition, it is possible that explanations of cooperative teaching strategy [henceforth, CTS] application, like the Think-Pair-Share (TPS), could be applied as explanations of conventional teaching. In the rest pertaining the world (Hsiung, 2012) a great amount of literature revealed that a teaching strategy in CTS for this millennium liberation, democratic, and Mathematics education has possibilities and benefits in socialising learners to share in different opinions, whilst at the same time motivating everyone to do work together on a mutual self-interest, in spite of differences that could otherwise separate them. The CTS may also help and benefit by mending unnecessary divisions among group members that are often based on race stereotypes that obstruct reforms and developments in the society if they are learnt and experienced by all school subject teachers.

One of the underpinning contextual philosophies of CTS for SA learners is the philosophy of *Ubuntu* and "African Renaissance". *Ubuntu* gives us a "balanced view", with *Ubuntu* representing African communalism versus the Western individualism of liberal democracies. The implications of *ubuntu* in cooperative learning are defended and the contents of individualism engraved in the Western and Eurocentric traditional teaching strategies (individual rights and freedoms, personal achievements, etc.) are seen as selfishness. Liberal democracies over-emphasise the individual above the community. The main deficiency of liberal democracy is that it cannot handle race (that is, communalism) as an element of democracy. On the other hand, the primacy of the society over the individual is best summed up by a well-known saying (of ubuntu), mathematically it means: 'I am one, and we are one: and since all we are one, therefore I am one'. Thus, *ubuntu* is seen as an alternative view to the liberal democratic system in SA (Bitzer, 2001, p. 102). A learners' experimental and natural world can be manipulated as the footing on which to start the forming of opinion and know-how. The teacher is called for the use of group work and pair-share to integrate knowledge. A five-point paradigm-shift, from the traditional teacher centredness towards learner centred CTS for Mathematics teachers as communicated in the National Council for Teachers of Mathematics [NCTM] (2014) proposes a: 1) Pro mathematical evidence and logic as proof reference – to do away with teacher as the only knowledgeable person; 2) Pro rationality to mathematical thinking – to do away with rote learning; 3) Pro problem solving, inventing and conjecturing – to do away with the overstatement of robotic solution reply.

Algebra and Geometry is presented to SA children around the ages of 13 and 14 years. While learners in SA may be taught Algebra and Geometry with impractical comprehension and calculation, it is important to observe whether the CAPS document is harmonious with this view. Das (2015) highlighted that, with Mathematics knowledge rests a critical function in advancing career opportunities for school learners. Howbeit, today many learners are struggling with Mathematics and as they are not motivated as they time to time are confronted with different challenges of engagement. Das also pointed out that a good number of studies were carried out in SA which were relevant nationally, provincially and district-wise. These studies assessed learners' levels of performance in compulsory grade subjects, such as Mathematics. The studies consistently reported learners' low levels of performance in Mathematics comparable to other teaching subjects. These studies attributed the low levels of learners' achievement in Mathematics to many different factors. Gamit, Antolin and Gabriel (2017) affirmed that mathematical achievement points to the learners' accomplishments in tasks that can be assessed through examination.

## II. RESEARCH METHODOLOGY

The aim of this section is to demonstrate and provide the research techniques and steps that were followed during and after data collection in order for the researcher to be able to test the hypothesis.

***Paradigm***

This study is located in the positivist paradigm. This paradigm is suitable to the nature of this study and the research hypothesis to be tested. The positivist paradigm is based on the concept of a reality that exists before the existence of written records. It holds that causal explanation based on randomised experimentation is the highest standard of knowledge (Alexander, 2014). As a matter of fact, its philosophy is based on the concept of a reality that exists before the problem.

***Research Approach***

A quantitative research approach was adopted for this study. Since this approach is about the collection of information in digital format, it is suited for the purpose of this thesis and the null hypotheses to be tested. This study is all about, to show how school location and teaching strategies affect learners' Mathematics performance.

***Research Design***

This study adopted a field- or quasi-experimental research design, which is conducted outside a laboratory, in a natural setting. It is a real world rather than the simulated world of the laboratory. This design was adopted for a number of reasons: this study was carried out in three different school locations, using learners in a regular classroom setting characterised as being able:

1. To carry a pretest~post-test group design in three school locations;
2. An opportunity to manipulate external independent variables involved in the study in order to ascertain whether there are any effects, for example, school location; and
3. To test effects of each.

***Population, Sample, and Sampling Techniques***

The target population for this study were Grade 9 learners in the Buffalo City Metro education district. A judgemental sampling technique was used to select 297 participants which were Grade 9 learners.

***Data Collection Instruments***

Underneath are the two research instruments which were employed:

1. Mathematics Achievement Test 1 (MAT1); and
2. Mathematics Achievement Test 2 (MAT2)

***Validity and Reliability***

The test content came directly from the prescribed CAPS senior document and CAPS compliant Grade 9 Mathematics textbooks of the destined schools. The reason for doing this was that the test content had to comply with the curriculum coverage as stipulated in the CAPS document and destined schools so as not to disturb or interfere with the daily running of the schools' timetable and curricular. Different writers addressed the issue of validity and reliability differently. The MATs were given to the Mathematics teachers of the selected schools, education district Mathematics subject advisor, and my research supervisor for review and comments.

***Data Analysis***

Learners' mathematical achievement results were gathered and analysed using both descriptive and inferential statistics. Analysis of Variance (ANOVA) was applied in testing the formulated hypothesis.

## III. RESEARCH FINDINGS

***Testing of Null Hypothesis***

**Null Hypothesis ($H_O$)**: There is no significant interaction effect of the teaching strategy (traditional versus cooperative) and school locations (uptown vs township vs rural).

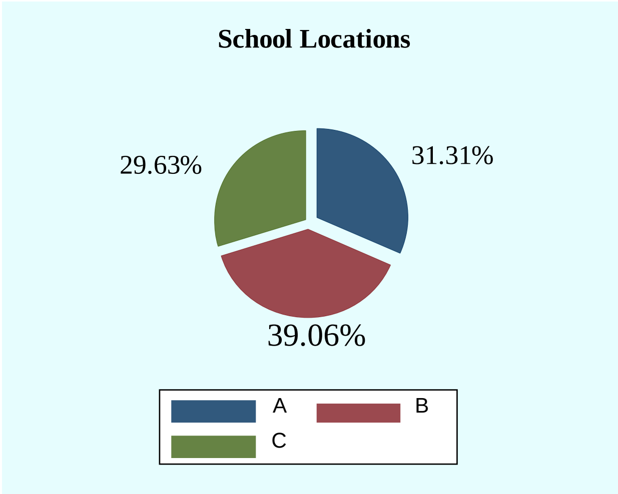
**Table 1: Demographic Background for the Sample**

**Tabulation of Schools' Locations**

| School location | Freq. | Percent | Cum. |
|---|---|---|---|
| School A | 93 | 31.31 | 31.31 |
| School B | 116 | 39.06 | 70.37 |
| School C | 88 | 29.63 | 100.00 |
| Total | 297 | 100.00 | |

Table 1 and Figure 1 show observation of learners across by school locations, 93 (31.31%) are from school A (uptown), while 116 (39.06%) are from school B (in the township). While 88 (29.63%) learners are from school C (rural). The school with the highest percentage of learners is the township school (39.06%), while the uptown (31.31%) and rural (29.63%) schools have nearly an equal percentage number of learners.

**Figure 1: School Based Observations**




A two-way ANOVA was run on a sample of 297 participants to examine the effect of teaching strategy and school location on learner performance (scores). There was a significant interaction between the effects of teaching strategy and the location of school on learners' performance, $F_{(2,291)} = 5.31$, $p = .0054$.

**Table 2: Analysis of Variance (ANOVA) of Learners' Mathematics Performance by School Location, and Teaching Strategy.**

Number of obs = 297 R-squared = 0.4777
Root MSE = 6.28377 Adj R-squared = 0.4688

| Source | Partial SS | df | MS | F | Prob>F |
|---|---|---|---|---|---|
| Model | 10510.976 | 5 | 2102.1951 | 53.24 | 0.0000 |
| School_location | 2915.1418 | 2 | 1457.5709 | 36.91 | 0.0000 |
| Teaching_strategy | 7435.5804 | 1 | 7435.5804 | 188.31 | 0.00 |
| Sch_loc#Teach_strat | 419.71032 | 2 | 209.85516 | 5.31 | 0.0054 |
| Residual | 11490.344 | 291 | 39.485719 | | |
| Total | 22001.32 | 296 | 74.328783 | | |

Sample main effects analysis in Table 3, showed that learners from school location A's (uptown) performance is highest, followed by school location B (township) learners and lastly, school location C (rural) learners. On the other hand, cooperative teaching strategy learners perform significantly better (average 20.98; t = 38.20; p =.000) than traditionally taught ones (mean = 11.05; t = 22.65; *p* = .002). It can also be observed that uptown learners under cooperative teaching strategy perform the best, while rural learners taught in the traditional way perform the worst.

**Table 3: Main Effect of School Location and Teaching Strategies on Learners' Mathematics Performance**

| | Delta-Strategy Margin | Std. Err. | t | P>\|t\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| **School location** | | | | | | |
| **School_A** | 18.87351 | .6517561 | 28.96 | 0.000 | 17.59075 | 20.15626 |
| **School_B** | 16.04044 | .5837272 | 27.48 | 0.000 | 14.89157 | 17.1893 |
| **School_C** | 10.98128 | .6699688 | 16.39 | 0.000 | 9.662677 | 12.29987 |
| **Teach_strategy** | | | | | | |
| **Cooperative** | 20.98012 | .5492394 | 38.20 | 0.000 | 19.89913 | 22.0611 |
| **Traditional** | 11.04749 | .4878417 | 22.65 | 0.000 | 10.08735 | 12.00764 |
| **Sch_loc#Teach_strat** | | | | | | |
| **Sch_A#Coop** | 26.125 | .9935507 | 26.29 | 0.000 | 24.16954 | 28.08046 |
| **Sch_A#Trad** | 13.15094 | .8631417 | 15.24 | 0.000 | 11.45215 | 14.84974 |
| **Sch_B#Coop** | 20.09434 | .8631417 | 23.28 | 0.000 | 18.39555 | 21.79313 |
| **Sch_B#Trad** | 12.84127 | .7916801 | 16.22 | 0.000 | 11.28312 | 14.39941 |
| **Sch_C# Coop** | 16.71053 | 1.019362 | 16.39 | 0.000 | 14.70427 | 18.71678 |
| **Sch_C#Trad** | 6.46 | .8886588 | 7.27 | 0.000 | 4.710987 | 8.209013 |

To compare closely the differences across the school locations (only independent factor with at least three categories), Scheffe post-hoc mean comparison technique was used and the results are presented below.

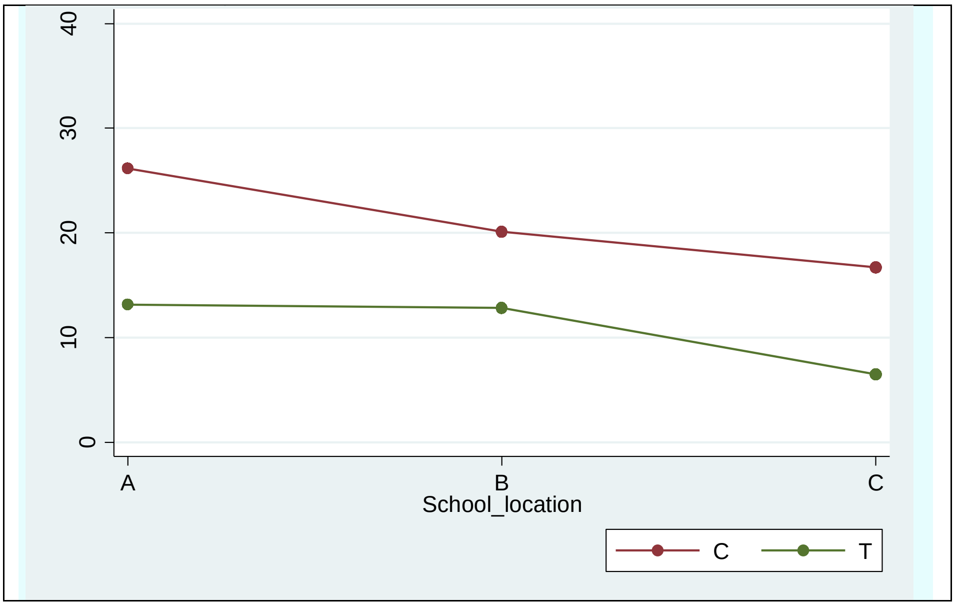
**Table 4: Scheffe Post-hoc Analysis of Learners' Mathematics Performance by School Location**

| Score | Contrast | Std. Err. | Scheffe t | Scheffe P>\|t\| | Scheffe [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| **School_location** | | | | | | |
| **B vs A** | -2.57601 | 1.122182 | -2.30 | 0.073 | -5.336882 | .1848613 |
| **C vs A** | -7.844819 | 1.198994 | -6.54 | 0.000 | -10.79467 | -4.894969 |
| **C vs B** | -5.268809 | 1.139739 | -4.62 | 0.000 | -8.072875 | -2.464742 |

All differences are statistically significant, at least at 5%, except for B vs A, which is significant at 10%. The greatest difference is between C vs A.

The chart below confirms that the cooperative teaching score is higher across all school locations, with the widest gap presenting within school A. Township school (B) exhibits the narrowest difference in scores between the teaching strategies.

**Figure 2: Teaching Strategies and School Location on Learners' Mathematics Performance.**




## IV. DISCUSSION

It was highlighted that there is a general perception that rural schools are inferior to the urban schools, as identified earlier in this manuscript. In rural schools, learner performance in comparison to schools elsewhere is weak. Rural School C's disadvantaged socio-economic background in terms of the lack of teaching and learning materials and other resources, has effects on the schools' learners' low performance compared to schools A and B, when taught Mathematics using TTS. These scores concur with the findings by Warthen (2017) that on *school locations* and the distribution of the results, the wealthier *uptown* former white ex-Model C school areas in the country tend to have *better-performing* schools, whereas the 'poverty-stricken' still languish in the *worst-performing* schools usually be found in the poorest former black SA *suburban townships* and former 'homeland' *rural* areas. However, the finding favoured cooperative TPS towards learners in all school locations. Similarly, the traditional strategy in Table 3, is equally in favour of A and B (uptown and township schools) over C (rural). Likewise, in the OECD countries, the extent of the performance gap between learners who attend schools in city locations and learners who attend schools in villages, that is, rural areas, varies greatly. "This difference in performance translates to about 20 PISA score points – the equivalent of half-a-year of schooling" (OECD, 2013, p.1).

This finding shows that in spite of the fact that Mathematics is compulsory and serves as a pre-requisite for studying in the universities and TVET colleges in pursuit of technical and vocational subjects among others, it is, therefore, regrettable that the rural learners still struggle with Mathematics and have performed abysmally low when taught using TTS in their Mathematics achievement test. Although rural areas differ from urban areas in many ways, it is not easy to define the differences so that they fit every case (Ntibi and Edoho, 2017; Ajai and Imoko, 2013).

## V. CONCLUSION

Significant variations were noted between learners in urban and rural schools in learning Mathematics. The researcher's observation has shown that many learners in rural settings live in poverty and their opportunities for learning and life experiences are limited, followed by the suburban township learners. The urban classrooms were set to be somehow more conducive to learning than the classrooms in rural and suburban township schools.

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***Conflict of Interest***

✓ *I, the Corresponding Author, declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere.*

✓ *I, the Corresponding Author, confirm that the manuscript has been read and approved by all named authors. I further confirm that the order of authors listed above has been approved by all of us.*

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