

The Effects of Gender and Teaching Strategies on Senior Secondary School Learners' Academic Achievement in the Buffalo City Metropolitan Municipality, South Africa

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Abstract:

Learning Mathematics is not fun for most female and male learners enrolled in public and private schools, instead, it is viewed with trepidation and described as a nightmare. To turn this situation around, the teaching strategies applied by the teacher need to help both female and male learner overcome these difficulties. For this cause a quasi-experiment was carried out on three schools in the Buffalo City Metropolitan Municipality. The individual variables (Gender#Teaching_strategies) were significant. According to the marginal means, the male and female learners' average scores were higher under cooperative teaching strategy (CTS) than in the traditional teaching strategy (TTS), but with a gap between female and male scores (females>males), while under TTS, males and females exhibit the narrowest difference in scores between scores. Both the male and female learners in the cooperative group improved their Mathematical achievement. That is, under CTS, female learners outperform male counterparts. The CTS works best for girl learners. While under TTS, female learners performed better than males. The difference in means is likely due to chance and not a reflection of the population. This implies that the TTS had about an equal effect on both male and female learners in the study. However, the interaction effect of gender (male versus female learners) and teaching strategies (CTS versus TTS) on learners' Mathematics performance on a sample of 297 learners were compared. A two-way analysis of variances (ANOVA) was conducted and the results showed no interaction effects as gender and teaching strategy were not statistically significant, $F_{(1, 293)} = 1.55, p = .2145$, thus the hypothesis is upheld.

Keywords: Gender, Teaching Strategy, Interaction Effect, Analysis of Variance, Mean Scores.

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I. INTRODUCTION

Since the attainment of democracy in 1994, international comparative studies have consistently demonstrated that SA learners lag behind other learners in Mathematics compared to the developed countries (for example, in the "Programme for International Students Assessment" [PISA] and TIMSS. On the issue of gender, the Southern and Eastern Africa Consortium for Monitoring Education Quality [SACMEQ] report indicated no significant gender differences among learners in SA and gender equality in the work place and in education is concerned. Otherwise gender differences come up when one group is perceived by the populace as possessing privileges than the other. In accord with the United Nations International Children's Emergency Fund [UNICEF] (2011), gender equality means both male versus female learner enjoy the same rights and opportunities. In addition, numerous tries had been done for the department to make the way of learning more efficient for both male and female learners.

Around the world, researches showed that learners' performance toward Mathematics is low. For instance, in a study in the Seychelles, female learners scored significantly higher than males in Mathematics. Vice versa, in Southern Africa countries, where males achieved significantly higher scores than females have done. But schools elsewhere in the world, together with some in South Africa, the variances were insignificant (see, Ajai & Imoko, 2015). Nevertheless, Okeke (2007) in his analysis of the studies, in Nigeria, concluded that gender disparities happen in learners' performances in other subjects. The studies displayed a considerable gap in favour of males sometimes for favour on females. Advocates of gender segregated classrooms showed that once learners are divided by gender, researchers can arrange lesson plans and tasks that select the learning approaches of female and male learners. In selected gender groupings, females' participation in Mathematics was better, that is generally believed to be the realm of males in co-education groupings; with the absence of males in groups, females participate and discuss more.

Hall (2008) argued that the females' and males' brains grow differently. While on the one hand, the females verbal or linguistic skills evolve early, on the other hand, males' brains develop geometric and mechanical intelligences. Males require extra social interaction compared to females during the learning process, that sometimes yield disciplinary consequences amongst learners. Hence, it is vital for learners to be self-regulating in their replies to straightforward equations in order that their tries can be concentrated on more strenuous mathematical tasks. Thus, effective approaches to teaching Mathematics need to be differentiated for females and males. This makes all the schooling subjects to be very important, Mathematics as one amongst many subjects that learners are underperforming in, needs urgent attention. In Mathematics performance, other than low achievement scores by learners, differences among male and female learners towards it are also a concern. "A gender-teaching strategy interaction provides a basis for predicting gender differences ... but this remains to be demonstrated" (Gupta, Jain & Pasrija, 2014, p. 56). This is the reason why this study hypothetically tried to find the difference amongst male and female learners performance results when they are taught Mathematics using traditional and cooperative teaching strategies.

In *Conquering Maths phobia* by Zakaria and Syamaun (2017), six beliefs have been identified that make learners find Mathematics challenging and ticklish to welcome as exciting and functional: (1) It is a monotonous subject, (2) It is challenging, (3) It is a subject that requires civility, (4) some people believe that women cannot do Mathematics, and (6) It is not relevant to everyday living. The aforementioned, further explained that Mathematics teachers need to dispel the misnomer inherent with the purpose that raise interest to learners. The poor Mathematics assessment scores can often be attributed to negative attitudes of disinterest, the subject being too challenging and learners having a fear of failure. Also, Okeke (2007) argued that groupings that involve only male learners, males can take advantage of their aggressive nature and promote for more talking and commotion which are features of their learning style. Hall (2008) contended that even if there are germane reasons for gender segregated classes, if the males and females are to cooperate as equals at the world of work, it must start in the classroom. Usually, males choose to work separately or in competitive settings on the other hand, females choose to work with the same gender in social groups or collaborative pairs. Hence, cooperative or 'group' teaching is an approach in which males can also be high achievers if it is arranged with sufficient and particular exercises to contribute to the roles for each group of gender (Hall, 2008).

II. RESEARCH METHODOLOGY

The term "methodology" in this section refers to a well-articulated, conceptually sound technique to data collection. It helped the researchers in choosing the kind of data that was needed for a chosen study and what types of data collection techniques were best suited for the chosen study's objective.

Research Paradigm

The positivist paradigm was used in this research. The necessity and constraints of this study influenced the choice of this paradigm, rather than a strong insistence on sticking to a certain philosophical outlook to the exclusion of others.

The expression positivism means a branch of philosophy which gained its significance in the early 1800s on the account of the work of Auguste Comte (1798-1857), a French metaphysicist. It is assumed that reality is not brought about by our soundness of mind; rather, it is controlled by non-negotiable laws, i.e., reality is contextless (Rehman & Alharthi, 2016).

Research Approach

This study followed the quantitative research approach. 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. The researcher gathers data with the aid of more structured research instruments which help to extract information that is suitable for testing formulated null hypotheses and theories. Such research rests upon the gathering of quantitative data (Johnson and Christensen, 2017). This approach entails quantitative techniques that are often thought to be based on positivism (Wells and Stage, 2015).

Research Design

It states the steps followed in accomplishing the stated research objective. The pretest and post-test group quasi-experimental design which employed mathematical achievement test (MATs) scores and statistical software programme to collect and analyse data, and to test it as a means to satisfactorily reject or accept the hypothesis stated in this study. It was specifically adapted in this approach to determine the main interaction effects on gender (female vs male) and teaching strategy (cooperative versus traditional) on learners' Mathematics performances in the Grade 9 classes.

Population, Sample, and Sampling Techniques

The target population which was identified and agreed upon, were the Grade 9 Mathematics learners in the Buffalo City Metropolitan Municipality (BCMM) education district, are a population within the larger population of the Eastern Cape Department of Education (ECDoE). A judgemental sampling, also called an expert sampling, which is an example of random sample collected resting on the decision of the researcher. The random sampling technique was used to sample 297 learners.

Data Collection Instruments

Two research instruments were employed for collecting data:

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 designated 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. A two-way ANOVA was conducted on the sample to test the formulated

III. RESEARCH FINDINGS

Null Hypothesis Testing

Null Hypothesis (H₀): There is no significant interaction effect of gender (male versus female learners) and teaching strategies (CTS vs TTS) on learners’ Mathematics performance.

Data presentation and analysis begins with demographic background. Description of variables in the category of gender and teaching strategies based on learner observations with a scale of frequencies and percentages. In summary, this is shown in Table 1 (a & b) a Figure 1 (a &b) below.

Table 1 (a & b): Demographic Background for the Sample

(a) Tabulation of Gender			
Gender	Freq.	Percent	Cum.
Female	155	52.19	52.19
Male	142	47.81	100.00
Total	297	100.00	

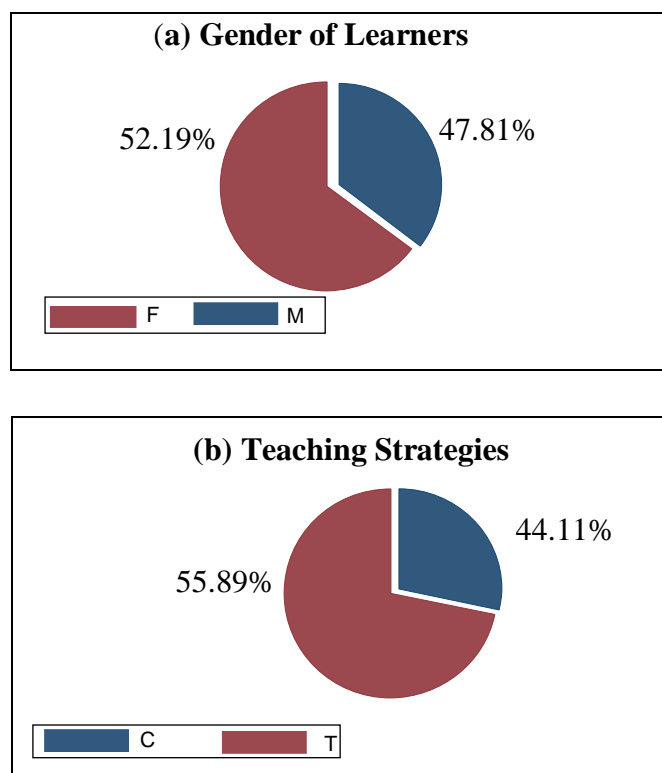
(b) Tabulation of Teaching Strategies			
Strategy	Freq.	Percent	Cum.
Cooperative	131	44.11	44.11
Traditional	166	55.89	100.00
Total	297	100.00	

This means, in a sample of 297 learners:

(a) Observation of learners by gender, 155 (52.19%) of them are female and 142 (47.81%) are male learners. The number of females is more than the males (female > male).

(b) While observation of learners by the researcher in teaching sessions applying the respective teaching strategies was being conducted, under the cooperative approach, 131 (44.11%) learners voluntarily participated in the MAT, while under the traditional one, 166 (55.89%) voluntarily participated in the MAT. Fewer learners participated in the MAT conducted after the use of CTS than after the TTS sessions (cooperative < traditional).

Figure 1(a) & (b): Illustrative Summary of School Based Observations



A two-way ANOVA is conducted on a sample of 297 participants to check the interaction effects (i.e. hypothesis 3&4 combined) and the results show no interaction effects as gender and teaching strategy (Gender#Teaching_Strategies) are not statistically significant, $F_{(1, 293)} = 1.55$, $p = .2145$. Thus, the hypothesis is upheld. This means that gender and teaching strategy had no effect on learners' Mathematical performance. This result is in favour of the findings of Chinyere, Ngozi and Chinelo (2019) in Physics; in agreement with findings of Udu (2017, pp. 9-11) on comparative effects of individualised "chalk and talk" and cooperative learning instructional strategies on senior secondary school learners' academic achievement in Organic Chemistry; also consistent with the findings of Ogbuanya and Owodunni (2015) on the study of effects of reflective inquiry instructional technique on learners' academic achievement and ability level in electronic work trade at technical college.

It disagrees with the findings of Dania (2014) conducted in Social Studies; findings of Okeke (2018) on interaction effect of gender and treatment (teaching strategy) using the mend mapping teaching strategy (MMTS) and the conventional teaching method (CTM).

Table 2: Analysis of Variance (ANOVA) of Learners' Mathematics Performance by Gender and Teaching Strategies

Number of obs = 297		R-squared = 0.3389				
Root MSE = 7.04584		Adj R-squared = 0.3321				
Source	Partial SS	df	MS	F	Prob>F	
Model	7455.6504	3	2485.2168	50.06	0.0000	
Gender	174.00423	1	174.00423	3.51	0.0622	
Teaching_strategy	7194.8963	1	7194.8963	144.93	0.0000	
Gender#Teaching_strategy	76.821375	1	76.821375	1.55	0.2145	
Residual	14545.669	293	49.643923			
Total	22001.32	296	74.328783			

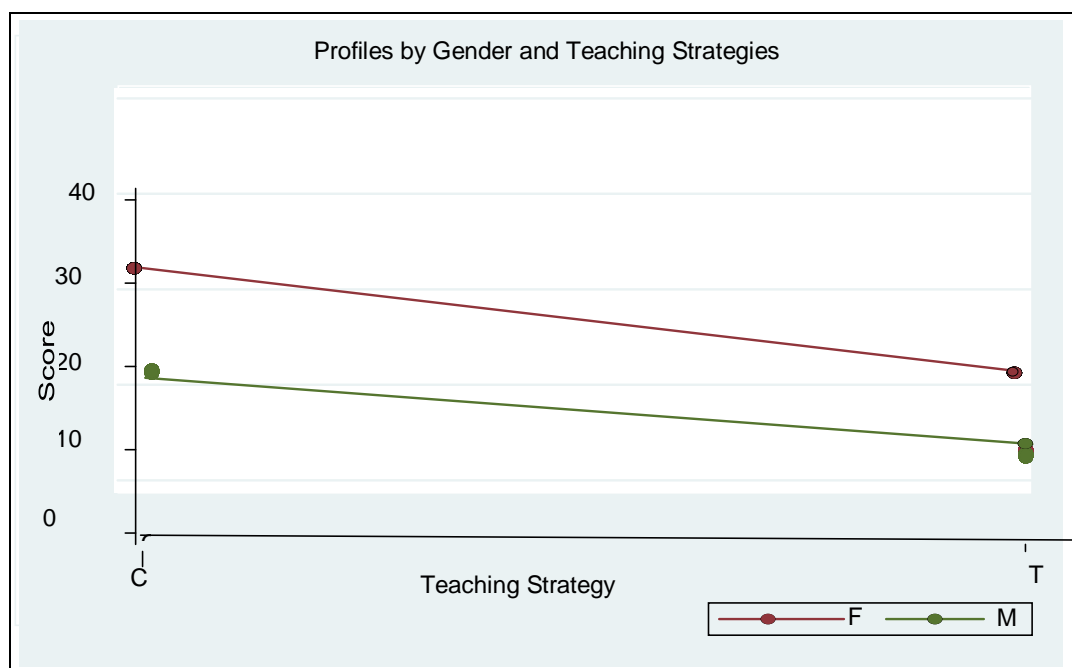
The individual variables (Gender, and Teaching strategy) are however significant. The mean scores for each group under gender (female vs male) and under teaching strategy (CTS vs TTS) are shown in the table and graph below and are statistically significant.

Table 3: Marginal Means for Learners' Mathematics Performance by Gender and Teaching Strategies

	Delta-strategy				[95% Conf. Interval]	
	Margin	Std. Err.	t	P> t 		
Gender						
Female	16.0901	.5660255	28.43	0.000	14.97611	17.20409
Male	14.66787	.5913848	24.80	0.000	13.50397	15.83177
Teaching_Strategy						
Cooperative	20.981	.6157324	34.07	0.000	19.76918	22.19282
Traditional	11.01381	.546938	20.14	0.000	9.937383	12.09023

The chart below confirms that both male and female learners' average scores are higher under CTS than in the TTS, but with a gap between female and male scores (females>males), while under TTS, males and females exhibit the narrowest difference in scores between scores.

Figure 2: Strategies on Learners' Mathematics Performance



That is, under CTS, female learners outperform male counterparts. The CTS works best for girl learners. This finding may encourage female learners to continue with cooperation and studies in Mathematics. Both the male and female learners in the cooperative group improved their Mathematical achievement in which the performance of female learners was significantly better than that of male learners after group learning treatment.

While under TTS, based on observations of gender differences, the findings revealed that, female learners performed better than males when taught using TTS. The difference in means is likely due to chance and not a reflection of the population. This implies that the TTS had about an equal effect on both male and female learners in the study. This finding negated the assumption that TTS produces an inequality gap in male and female achievement. It revealed that both male and female learners benefitted from the use of chalk and talk lecture format as a teaching strategy. The gender of a learner does not affect his or her performance in Mathematics. This is possible since written information on the “blackboard” is persistent and remains visible to learners, even after moving on to a new topic. This finding is emphatically presenting evidence to buttress the indispensability of the TTS.

IV. DISCUSSION

A two-way interaction effect was carried to determine the interaction effects on gender (female vs male) and teaching strategy (cooperative versus traditional). There was no significant interaction between the effects of gender and teaching strategy. Hence, the hypothesis was not rejected. This means that gender and teaching strategy had no effect on learners' Mathematical performance in this study. This result is in favour of the findings of Chinyere, Ngozi and Chinelo (2019) in Physics which showed that there is no statistically significant interaction between a teaching approach and gender on learners' conceptual understanding scores. The hypothesis was therefore accepted. This showed that there was no statistically significant interaction which existed between gender and teaching approach. The results also agreed with the findings of Gbenga and Effiong (2015) on “the effect of treatment, gender and study habits on learners' achievement in Basic Science. The findings show that there is no significant interaction effect of treatment, gender and study habits on learners' achievement in Basic Science” (p.74). This implied that treatment, gender and study habit did not combine to influence learners' achievement in basic science.

This result is also in agreement with the finding of Udu (2017, pp. 9-11) on comparative effects of individualised “chalk and talk” and cooperative learning instructional strategies on senior secondary school learners' academic achievement in Organic Chemistry. The calculated F-value for the interaction effect of method and gender on learners' achievement in Organic Chemistry was found to be 1.396 with P-value of 0.142, which is greater than 0.05 set for the study. The null hypothesis was therefore upheld. This means that

there is no significant interaction effect of method and gender on learners' academic achievement in Organic Chemistry.

This research's findings are also consistent with the finding of Ogbuanya and Owodunni (2015) on the study of effects of reflective inquiry instructional technique on learners' academic achievement and ability level in electronic work trade at technical college. "The interaction of treatments and gender [was] higher than .05, the null hypothesis for interaction effect of treatment and gender [was] accepted" (p.49). Hence, there was no significant interaction effect of treatments given to learners and their gender with respect to their mean scores on the electronic work trade achievement test. From another angle, this research's findings also support those of Usman, Yew and Saleh's (2019) study on the interaction effect of teaching strategy and gender on pre-service Mathematics teachers' attitude towards Geometry. The finding was found not to be significant. The null hypothesis was accepted. In other words, the effect of treatment (that is, teaching strategy) on attitude towards Geometry of the pre-service Mathematics teachers on post-test scores did not depend on the gender of the pre-service Mathematics teachers.

The result is, however, in disagreement with the following studies (just to touch on the few for the limited scope of this study): Dania (2014, pp. 79 & 81) conducted a study to test the hypothesis on the interaction effect of treatment and gender on learners' academic achievement in Social Studies. The findings showed significant interaction effect of treatment and gender on learners' academic achievement in social studies. Facts showed that there exists a significant interaction between treatment and gender on learner academic achievement. Thus, the null hypothesis was rejected. The study of Adeyemi (2008) on "the effects of cooperative learning and problem-solving strategies on junior secondary school learners' achievement in Social Studies addressed the research question: Is there any significant interaction effect of treatment (teaching strategy) and gender on achievement in Social Studies among JSS2 learners?" (p.691). Data on analysis of covariance of Social Studies test scores by treatment (teaching strategies) and gender showed in the results "a significant main effect of treatment as well as significant interaction effects of treatment and gender" (p. 701). Findings of Okeke (2018, pp. 32&48) showed that there was a significant interaction effect of gender and treatment (teaching strategy) on mean achievement scores of learners taught using the mind mapping teaching strategy (MMTS) and those taught with the conventional teaching method (CTM). The null hypothesis of no significant interaction effect of gender and treatment on mean achievement score of learners taught was thus rejected.

V. CONCLUSION

The interaction effect of gender and teaching strategies in this study is not significant. Based on the finding of this study, it could be concluded that under CTS, female learners outperform their male counterparts. The CTS works best for girl learners. It then means that teaching strategy does not depend on gender to be effective.

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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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