

Mode of Test Administration, Birth Variables, and Students' Academic Achievement in Mathematics in Obubra Local Government Area of Cross River State, Nigeria

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Abstract

This study assessed the mode of test administration, birth variables, and students' academic performance in Mathematics in Obubra Local Government Area of Cross River State, Nigeria. The study was guided by three null hypotheses following a quasi-experimental research design. Simple random and purposive sampling techniques were employed in selecting a sample of 250 respondents from a population of 5,792 students. Birth Order Checklist (BOC) and Mathematics Achievement Test (MAT) were used for data collection. The experimental group was assigned to take a Computer-Based Test (CBT) while the control group took a Paper-Pencil Test (PPT) in mathematics. The null hypotheses were tested at .05 alpha level using two-way analysis of variance. Major findings revealed that, the interactive effects of gender and mode of test administration on the academic performance of students is non-significant [$F(1,249)=0.028, p>.05, \text{partial } \eta^2=.000$]; the interactive effects of gender and birth order on the academic performance of students was not statistically significant [$F(3,249)=0.782, p>.05, \text{partial } \eta^2=.010$]; the interactive effect of gender and birth order on the academic performance of students in mathematics is statistically significant [$F(3,249)=2.854, p<.05, \text{partial } \eta^2=.034$]. Based on these findings conclusions and recommendations were made for improved academic performance and school system effectiveness.

Keywords: Test, administration, birth, order, academic, performance

Introduction

The objective of secondary education as well as societal expectations appears to have met some bottlenecks based on the poor academic performance of many secondary school students in Mathematics. It was expected of learners that upon completion of the basic education level, learners in secondary school should demonstrate a good grasp of literacy, numeracy, communication and life skills which should enable the child to function effectively, adjust, and fit seamlessly to the societal dynamics in the 21st century. The acquisition of such skills will have further made the individuals (learners) become not only relevant to themselves, but also to their families, and the society at large. This would have further impacted on the quality of candidates supplied to tertiary institutions, and consequently, the manpower of the Nigerian economy for rapid growth and development.

So far, this expectation still appears to be a mirage as many secondary school students and even school leavers have been found to be lacking the basic numeracy skills of counting and arithmetic, arising from issues in the teaching and learning of mathematics. Apart from the problems of teaching and learning, one serious issue that has bedevilled the subject of Mathematics is the academic performance of students. The rate at which secondary school students are under-performing in Mathematics test, examination, or both is very alarming. Observation and experience have shown that many students including those in senior secondary classes lack the basic arithmetic skills of addition, subtraction, multiplication, and division.

Reacting to this, Owan, Nwannunu and Madukwe (2018) reported that secondary school students' academic performance generally is unstable, poor and dwindling, with many students struggling when they take classroom or external examinations. The high rate of examination malpractice by secondary school students is an indicator of poor students' academic performance (Arop, Ekpang, Nwannunu & Owan, 2018; Bassey, Owan & Agunwa, 2019). The persistent increase in the poor performance of students especially in a subject as important as Mathematics is threatening, questionable, unacceptable, and such that calls for urgent attention. The need for an intervention into the situation is urgent in view of the importance of Mathematics in the socio-economic development of the nation in general, and Obubra Local Government Area in particular.

Studies in the past have made efforts to address this issue of poor students' academic performance in Mathematics as well as other subjects. Factors such as problems of school management, quality assurance practices, school-community relationship, students' perception, students' personality, political, economic, home and psycho-social factors have been identified as correlates of students' academic performance (Umoinyang, 1999; Adeyemi & Adeyemi, 2014; Owan, Arop & Agunwa, 2019; Owan

& Ekaette, 2019). Specifically, Owan (2012) reported that learners' attitude, use of teaching aids by teachers, parental involvement, head teachers' administration, environmental influence, and parents' socioeconomic status are factors affecting students' academic performance in mathematics. The findings from these studies were either too general or have focused on variables that have not been able to address the issue of students' poor performance in mathematics. This present study takes a shift to consider the mode of administering test items, birth variables and how these interact with the performance of students in mathematics.

The mode of test administration takes into consideration, the form, nature, techniques, and environment in which test items which have been constructed by either a teacher or any other qualified person, are presented to the students who are to take such tests. A test could be administered in the form of an objective, essay, power, speed, intelligence or aptitude test. The choice is dependent on the individual who is administering it, including his/her objective for the administration of the test. A test could be administered either physically to the students or through the use of computers with the support of the internet. Test items could also be presented to an individual per time or to a group of students. In the group test, it is the choice of the administrator to decide on the sitting arrangement based on the available resources in the environment. Studies have shown that the administration of test items has a role to play in determining the academic performance of students (Steedle, Zahner & Kugelmass, 2014; Seidelman, 2014).

A study has also shown that there is no relationship between the mode tests are administered and the performance of tests takers and that only test anxiety has an association with computer- and paper-based testing (Patel & Laher, 2011). Garas and Hassan (2018) showed that there is no statistically significant difference between the students' paper-based and computer-based scores. However, benchmark regression analysis showed that males performed better than females on Computer-Based Test (CBT), and females outperformed males on Paper-Pencil Test (PPT). Karay, Schauber, Stosch and Schüttpelz-Brauns (2015) espouse that the results of students from the paper and computer versions did not differ. The groups remained within the allotted time, but students using the computer version (particularly the high performers) required significantly less time to complete the test. The study also found significant differences in the guessing behaviour where low performing students who took CBT guessed significantly more than low-performing students in the PPT.

Other studies, for example, Gallagher, Bridgeman and Cahalan (2000); and Leeson (2006), asserted the existence of gender effect on examination mode. Also, Oduntan, Ojuawo and Oduntan (2015) concluded that male students outperform female students on CBT. On the contrary, Jalali, Zeinali and Nobakht (2014) disclosed that female

students performed better than their male counterparts in both modes. Also, Wallace and Clariana (2005) discovered that male students were better than their female peers on the pre-test regardless of the test mode, whereas female students using CBT outperformed male students on the post-test. But Alexander, Bartlett, Truell and Ouwenga (2001) revealed that there is no significant gender difference in the performance of students in PPT and CBT respectively.

Birth variables, on the other hand, refer to the natural attributes that individuals are born with that are not manipulated in the environment. Birth variables are customized characteristics that are God-given, observable, and are not the same among members even of the same nuclear family. Such variables include gender, hair colour, eye colour, skin colour, height, birth order (first, second, third or fourth child), and others. These variables are mutually inclusive since it is possible for a person in category A to possess similar characteristics as another person in category B. However, there must be one unique birth variable that would differentiate one person from another no matter how close or similar they may appear. If the colour or facial appearance is the same, then something like the height or intelligence may differ, or people with all these traits being the same, may differ in the order of their birth etc.

This study's focus is on two important birth variables including students' gender and birth order. Birth order, in the context of this study, was operationalized into four categories – first born, middleborns, lastborns, and the only child in the family. This classification of birth order has no theoretical underpinning, but was done based on the assumption and common sense that in every family, there is always a first child and there is always a last born. There will always be those in the middle such as 2nd, 3rd, 4th....nth child before the last born.

In families where only one child exists, there is no birth order, but such should also be considered. The study avoided multiple births and polygamous families due to the complexities bordering around the birth order in these groups. Earlier studies have used similar classification of birth order (Vijendra, 2011; Nissenbaum, 2012).

Studies on birth order and academic performance have revealed mixed findings. The results of Tshui and Cai (2011) indicated that participants of different birth positions did not differ significantly in terms of personality and academic performance. However, Pearson's correlation showed that extraversion correlated positively with academic performance. Reyes-Baybay (2017) revealed that there is no significant relationship between the respondents' birth order and academic achievement. The respondents' birth order has little or no bearing on their academic achievement. In another study, Vijendra (2011) showed that significant differences are observed between the second born and last born, and second born and only child categories of

students. On the contrary, Manoranjan (2018) revealed from a study that there is no significant difference between first-born children and second born children on achievement motivation, there is no significant difference between first-born children and third born children on achievement motivation, and there is no significant difference between second-born children and third born children's achievement motivation.

In terms of birth order and gender, Akgeyik (2013) concluded from a study that there were statistically significant differences between the Academic Staff and Graduate Test (ASGT) scores of participants by gender and birth order. Rajen (2012) found that first-born children performed significantly better than those not first-born; first-born females performed significantly better than males who were not first-born, and first-born in two-children families performed significantly better than the last born of families of more than two children. Nissenbaum (2012) showed that only firstborns and middleborns who have the same gender as all of their siblings held the lowest scores for academic and social success. It was also found that these two populations were least likely to view their birth orders favourably.

The findings of Tobias (2003) discovered that males had a significantly higher mean than females on the dimension of a positive school climate. On the dimension of maximum opportunities for learning, middle-born and last-born males had significantly higher means than middleborn and last-born females. In the study of Siegle and Schuler (2000), firstborn students reported the highest level of parental criticism and expectations. Youngest students showed the lowest concerns in those areas. They cautioned parents of firstborn (albeit gifted) children.

A close perusal of the literature disclosed that there are different views, opinions, findings, and theoretical bases as it concerns the relationship between the mode of test administration, birth variables (in terms of order and gender), and students' academic performance respectively. While some studies have shown a significant relationship/influence/effect, others discovered rather a contrary result. This contradiction in the literature has made it quite difficult to pass value judgment since most of these were carried out in different parts of the world, with the majority of the studies conducted in Asian and European countries. Thus, the gap this study sought to fill was specifically that which is resulting from the paucity, scarcity, and limited literature on the subject matter of Obubra Local Government Area of Cross River State.

Purpose of the study

This study was conducted to assess the mode of test administration, birth variables, and students' academic performance in Mathematics from the perspective of Obubra Local Government Area of Cross River State, Nigeria. The study specifically assessed:

- i. The interactive effect of gender and mode of test administration on the academic performance of students in mathematics.
- ii. The interactive effect of gender and birth order on the academic performance of students' in mathematics.
- iii. The interactive effect of birth order and mode of test administration on the academic performance of students in mathematics.

Hypotheses

The following null hypotheses were formulated to direct the study:

Ho1: There is no significant interactive effect of gender and mode of test administration on the academic performance of students in mathematics.

Ho2: There is no significant interactive effect of gender and birth order on the academic performance of students in mathematics.

Ho3: The interactive effect of birth order and mode of test administration on the academic performance of students in mathematics is not statistically significant.

Methodology

This study adopted a quasi-experimental research design. This design was considered suitable for the study due to the manipulation and control of some variables to see their effects on the dependent variable. The population of this study comprised 5,792 secondary school students distributed across 16 public secondary schools in Obubra Local Government Area of Cross River State. This population includes both junior and senior secondary school students in government-owned schools in Obubra LGA.

A simple random sampling technique was adopted by the researchers in selecting a sample frame of 10 public secondary schools out of the 16 schools available in the area of study. Purposive sampling technique was then employed in selecting 25 students who are from monogamous families in each school, resulting in the selection of 250 students across the 10 selected schools in the sampling frame. Purposive sampling technique was used in order to select students who are firstborns, middleborns, lastborns, and only child in the family. The researcher did not involve any student from polygamous families and children born in multiple births (e.g. twins, triplets, and so on) since they have some extraneous variables which the researchers cannot control (such as multiple firstborns and lastborns). The researchers, therefore, made use of subjects who are from monogamous families. The researchers were able to draw out students from monogamous families by asking students in each class to indicate by raising up their hands.

Two instruments were used for data collection including a checklist titled Birth Order Checklist (BOC), and Mathematics Achievement Test (MAT). The BOC was designed by the researchers to obtain demographic and birth order details of the respondents. The MAT was constructed with 40 objective items adapted from the Junior Secondary Certificate Examination past question. The 40-item test was presented in two forms – paper and pencil test and Computer Based Test (CBT). The respondents were divided into two groups – the experimental group and the control group. The experimental group was assigned to take the computer-based test (CBT), while the control group was subjected to take the classical paper-pencil test (PPT). At the end of the exercise, scores from both tests were collected from both groups for analysis. The data collected were analysed using descriptive statistics such as mean and standard deviation while all the null hypotheses were tested using two-way analysis of variance.

Presentation of results

Ho1: There is no significant interactive effect of gender and mode of test administration on the academic performance of students in mathematics.

This hypothesis was tested at .05 alpha level of significance using the two-way analysis of variance and the results of the analysis are presented in Table 1.

The results in table 1 indicate that 154 male students were involved in this study out of which 81 took the PPT while 73 took the CBT. Similarly, there were 96 females out of which 57 took the PPT while 39 took the CBT. Out of 250 respondents selected for this study, 138 wrote the PPT while 112 took the CBT irrespective of gender.

The results showed further in table 1 that males who took the PPT scored better than males who took the CBT. Females who took the PPT demonstrated higher achievement than females who took the CBT. Generally, students who wrote the PPT scored higher than their counterparts who wrote the CBT irrespective of gender. In the test, it was revealed that males performed significantly higher than females in both tests.

Based on the mode of test administration perspective, the results presented in table 1 revealed that gender has a significant main effect on students' academic performance in mathematics { $F(1, 249) = 4.232, p < .05, \text{Partial } \eta^2 = .017$ }. The results also disclosed that the mode of test administration (MTA) has a significant main effect on the academic performance in mathematics of secondary school students { $F(1, 249) = 8.190, p < .05, \text{Partial } \eta^2 = .032$ } based on the perspective of gender.

Table 1: Two-way analysis of variance showing the interactive effect of gender and mode of test administration on the academic performance of students in mathematics

Gender	Mode of Test		Mean	SD	N
	Admin.				
Male	PPT		18.04	7.724	81
	CBT		15.08	8.677	73
	Total		16.64	8.296	154
Female	PPT		15.96	8.464	57
	CBT		12.64	8.731	39
	Total		14.61	8.684	96
Total	PPT		17.18	8.073	138
	CBT		14.23	8.735	112
	Total		15.86	8.487	250

Source	Type III		MS	F	Sig.	Partial η^2
	SS	Df				
Corrected Model	832.800 ^a	3	277.600	3.993	.008	.046
Intercept	55034.530	1	55034.530	791.572	.000	.763
Gender	294.237	1	294.237	4.232	.041	.017
MTA	569.449	1	569.449	8.190	.005	.032
Gender * MTA	1.967	1	1.967	.028	.867	.000
Error	17103.300	246	69.526			
Total	80821.000	250				
Corrected Total	17936.100	249				

a. R Squared = .046 (Adjusted R Squared = .035)

The interactive effects of gender and the mode of test administration on the academic performance of students revealed a non-significant result {F (1, 249) = 0.028, $p > .05$, Partial $\eta^2 = .000$ }. With these results, the null hypothesis was retained implying that gender and the mode of test administration have no significant interactive effect on students' academic performance in mathematics. Gender and the mode of test administration explained 35% of the variability in students' academic performance in mathematics with the remaining 65% of the total variance explained by other independent variables not included in the model. These results are further expressed in Figure 1 for clarity purposes.

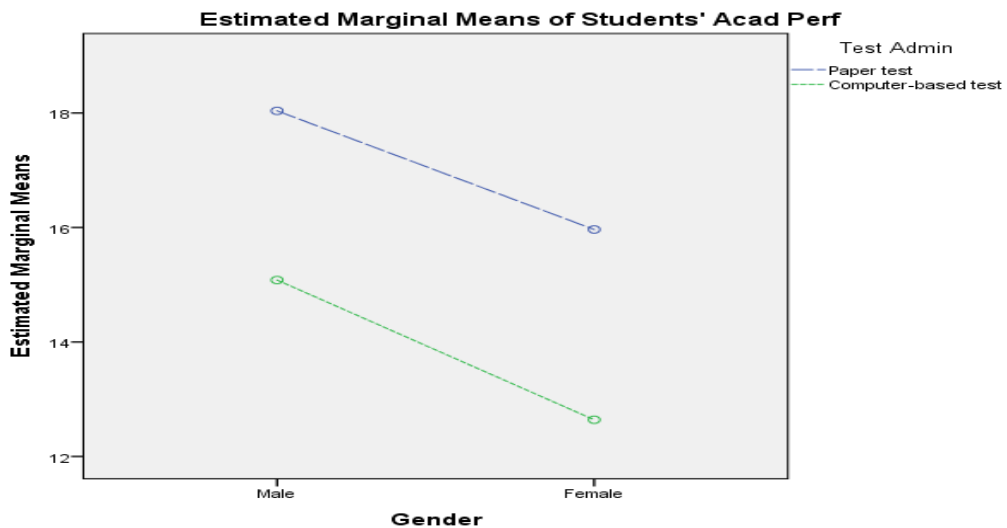


Figure 1: Students academic performance in Mathematics based on gender and mode of test administration.

Ho2: There is no significant interactive effect of gender and birth order on the academic performance of students in mathematics.

This null hypothesis was tested using two-way ANOVA at .05 level of significance. The results of the analysis of data are presented in Table 2.

The results as presented in Table 2 disclosed that out of the 250 respondents selected for this study, 154 were males while 96 were females. It was also discovered that the 64 of the selected respondents were firstborns, 89 were middleborns, 70 were lastborns, and 27 were the only children in their families. Out of the 154 males, 34 were firstborns, 45 were middleborns, 50 were lastborns, and only 25 were the only children. Out of the 96 females, firstborns were 30, middleborns were 44, lastborns were 20, and 2 were the only children.

The results in table 2 also showed that firstborns who are males scored higher than firstborns who are females. Middleborns who are males scored less than middleborns that are females. Lastborns who are males outperformed lastborns who are females. While the only children in their families who are males scored lower than the only children who are females. Generally, the only children in their families scored higher than firstborns, lastborns, and middleborns.

Table 2: Two-way ANOVA results summary showing the interactive effects of gender and birth order on the academic performance of students in mathematics

Gender	Birth Order	Mean	SD	N
Male	Firstborns	17.56	7.982	34
	Middleborns	14.13	8.846	45
	Lastborns	16.70	8.094	50
	Only child	19.76	7.126	25
	Total	16.64	8.296	154
Female	Firstborns	16.17	7.575	30
	Middleborns	14.18	9.706	44
	Lastborns	12.60	7.639	20
	Only child	21.00	9.899	2
	Total	14.61	8.684	96
Total	Firstborns	16.91	7.764	64
	Middleborns	14.16	9.228	89
	Lastborns	15.53	8.129	70
	Only child	19.85	7.124	27
	Total	15.86	8.487	250

Source	Type III SS	Df	MS	F	Sig.	Partial η^2
Corrected Model	1039.946 ^a	7	148.564	2.128	.041	.058
Intercept	24314.771	1	24314.771	348.255	.000	.590
Gender	24.622	1	24.622	.353	.553	.001
Birth Order	487.121	3	162.374	2.326	.075	.028
Gender * Birth Order	163.695	3	54.565	.782	.505	.010
Error	16896.154	242	69.819			
Total	80821.000	250				
Corrected Total	17936.100	249				

a. R Squared = .058 (Adjusted R Squared = .031)

Based on the perspective of birth order, the results in table 2 indicate that gender has no significant main effect on the academic performance of students in mathematics {F (1, 249) = 0.353, $p > .05$, Partial $\eta^2 = .001$ }. It was also revealed that birth order has no significant main effect on students' academic performance in mathematics {F (3, 249) = 2.326, $p > .05$, Partial $\eta^2 = .028$ } based on the perspective of gender.

The interactive effects of gender and birth order on the academic performance of students was not statistically significant {F (3, 249) = 0.782, $p > .05$, Partial $\eta^2 = .010$ }. Based on this result, the null hypothesis stated earlier was retained implying that gender and birth order have no significant interactive effect on the academic

performance of students in mathematics in Obubra Local Government Area of Cross River State. Gender and birth order jointly explained 31% of the total variance in the academic performance of students in mathematics with the remaining 69% of the variability accounted for by other independent variables not included in the model. These are also expressed in Figure 2 for a better understanding.

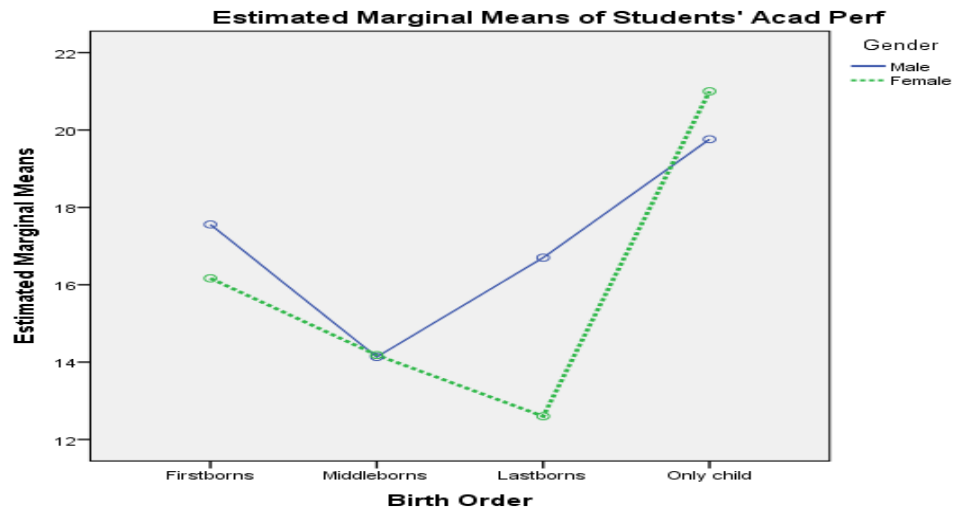


Figure 2: Students academic performance in Mathematics based on gender and birth order.

Ho3: The interactive effect of birth order and mode of test administration on the academic performance of students in mathematics is not statistically significant.

This null hypothesis was tested at an alpha level of .05 using a two-way analysis of variance. The results from the analysis of data are presented in table 3. The result in table 3 showed in the Paper-Pencil Test (PPT) category that firstborns who took the PPT were 35, middleborns who took the PPT were 50, lastborns who took the PPT were 37 while only children in the family who took the PPT were 16. On the whole, 138 students took the PPT in mathematics and achieved a mean and standard deviation of 17.18 and 8.073 respectively. It was shown in the Computer-Based Test (CBT) section that 112 students sat for the CBT with 29 of these being firstborns, 39 being middleborns, 33 lastborns, and 11 being the only children in their families. Irrespective of test type, 64 firstborns, 89 middleborns, 70 lastborns, and 27 only children took either PPT or CBT out of the 250 students used in the study.

The results also indicate that firstborns who took the PPT scored lower than firstborns who took the CBT. Middleborns who took the PPT scored higher than middleborns who took the CBT. Lastborns who took the PPT outperformed their counterparts who

took the CBT. Lastborns who took the PPT scored lower than lastborns in the CBT category. Generally, students scored lower in PPT than in CBT irrespective of their birth order.

The test between-subject effects section of Table 3 further indicates that, the mode of test administration (MTA) has no significant main effect on students' academic performance in mathematics {F (1, 249) = 2.450, p> .05, Partial $\eta^2 = .010$ } based on the perspective of birth order. Birth order was shown to have a significant main effect on the academic performance of students in mathematics {F (3, 249), p< .05, Partial $\eta^2 = .053$ } from the mode of test administration perspective.

The interactive effect of gender and birth order on the academic performance of students in mathematics is statistically significant {F (3, 249) = 2.854, p< .05, Partial $\eta^2 = .034$ }. With these results, the null hypothesis was rejected while the alternate hypothesis was upheld. The implication of this result is that the mode of test administration and birth order has a significant interactive effect on the academic performance of students in mathematics. The mode of test administration and gender accounted for 78% of the total variance in students' academic performance in Mathematics with the remaining 22% of the variance explained by other extraneous variables that were not included in the model. These results were further presented in Figure 3 for clarity.

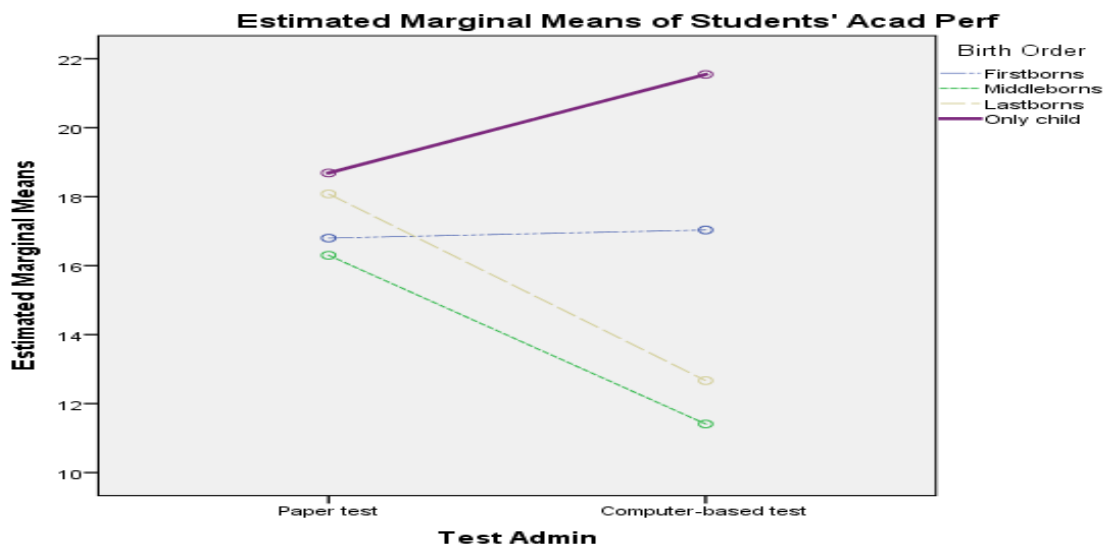


Figure 3: Students' academic performance in Mathematics based mode of test administration and birth order.

Table 3: Two-way analysis of variance results showing the interactive effects of mode of test administration and birth order on the academic performance of students in Mathematics

Mode of Test Admin (MTA)	Birth Order	Mean	SD	N
Paper-pencil test	Firstborns	16.80	8.069	35
	Middleborns	16.30	9.054	50
	Lastborns	18.08	6.914	37
	Only child	18.69	7.605	16
	Total	17.18	8.073	138
Computer-based test	Firstborns	17.03	7.519	29
	Middleborns	11.41	8.816	39
	Lastborns	12.67	8.528	33
	Only child	21.55	6.314	11
	Total	14.23	8.735	112
Total	Firstborns	16.91	7.764	64
	Middleborns	14.16	9.228	89
	Lastborns	15.53	8.129	70
	Only child	19.85	7.124	27
	Total	15.86	8.487	250

Source	Type III SS	Df	MS	F	Sig.	Partial η^2
Corrected Model	1855.344 ^a	7	265.049	3.989	.000	.103
Intercept	54981.539	1	54981.539	827.420	.000	.774
MTA	162.816	1	162.816	2.450	.119	.010
Birth Order	908.030	3	302.677	4.555	.004	.053
MTA * Birth Order	568.955	3	189.652	2.854	.038	.034
Error	16080.756	242	66.449			
Total	80821.000	250				
Corrected Total	17936.100	249				

a. R Squared = .103 (Adjusted R Squared = .078)

Discussion of findings

The first finding of this study established that the interactive effects of gender and the mode of test administration on the academic performance of students is non-significant {F (1, 249) = 0.028, $p > .05$, Partial $\eta^2 = .000$ }. However, based on the mode of test administration perspective, the results discovered that gender has a significant main effect on students' academic performance in mathematics {F (1, 249) = 4.232, $p < .05$,

Partial $\eta^2 = .017$ }. This finding aligns with the results of Alexander, Bartlett, Truell and Ouwenga (2001) which revealed that there is no significant gender difference in the performance of students in PPT and CBT respectively. Other studies, for example, Gallagher, Bridgeman and Cahalan (2000), and Leeson (2006) also showed that there is a significant effect of gender on examination mode.

The study also disclosed that the mode of test administration (MTA) has a significant main effect on the academic performance in mathematics of secondary school students { $F(1, 249) = 8.190, p < .05, \text{Partial } \eta^2 = .032$ } based on the perspective of gender. This finding is in line with the findings of earlier studies which have shown that test administration has a nexus with the academic performance of students (Steedle, Zahner & Kugelmass, 2014; Seidelman, 2014). This finding, however, disagrees with the results of some earlier studies (Patel & Laher, 2011; Karay, et al., 2015; Garas & Hassan, 2018) which showed that there is no statistically significant difference between the students' paper-based and computer-based scores.

This study showed further that males who took the PPT scored better than males who took the CBT. Females who took the PPT demonstrated higher achievement than females who took the CBT. Students who wrote the PPT scored higher than their counterparts who wrote the CBT irrespective of gender. In the test, it was revealed that males performed significantly higher than females in both tests. This finding corroborates the findings of Oduntan, Ojuawo and Oduntan (2015), which concluded that male students outperformed female students on CBT. Wallace and Clariana (2005) discovered that male students were better than their female peers on the pre-test regardless of the test mode, whereas female students using CBT outperformed male students on the post-test. On the contrary, Jalali, Zeinali and Nobakht (2014) disclosed that female students performed better than their male counterparts in both modes.

The second finding of this study showed that the interactive effects of gender and birth order on the academic performance of students were not statistically significant { $F(3, 249) = 0.782, p > .05, \text{Partial } \eta^2 = .010$ }. However, based on the perspective of birth order, it was discovered that gender has no significant main effect on the academic performance of students in mathematics { $F(1, 249) = 0.353, p > .05, \text{Partial } \eta^2 = .001$ }. The result of this study is consistent with the finding of Rajen (2012) which found that first-born children performed significantly better than those not first-born; first-born females performed significantly better than males who were not first-born, and first-born in two-children families performed significantly better than last born of families of more than two children. This result, however, disagrees with the results of Akgeyik (2013) who concluded from a study that there were statistically significant differences between the Academic Staff and Graduate Test (ASGT) scores of participants by gender and birth order.

The study also showed that birth order has no significant main effect on students' academic performance in mathematics { $F(3, 249) = 2.326, p > .05, \text{Partial } \eta^2 = .028$ } based on the perspective of gender. This finding agrees with the results of Tshui and Cai (2011) which also indicated that participants of different birth positions did not differ significantly in terms of personality and academic performance. Similarly, Reyes-Baybay (2017) revealed that there is no significant relationship between the respondents' birth order and academic achievement.

It was also discovered that firstborns who are males scored higher than firstborns who are females. Middleborns who are males scored less than middleborns that are females. Lastborns who are males outperformed lastborns who are females. While the only children in their families who are males scored lower than the only children who are females. Generally, the only children in their families scored higher than firstborns, lastborns and middleborns. This finding supports the finding of Vijendra (2011) which showed that significant differences are observed between the second born and last born, and second born and only child categories of students. Contrary to this result, Manoranjan (2018) revealed from a study that there is no significant difference between first-born children and second born children on achievement motivation.

The third finding of this study disclosed that the interactive effect of gender and birth order on the academic performance of students in mathematics is statistically significant { $F(3, 249) = 2.854, p < .05, \text{Partial } \eta^2 = .034$ }. Relatively, it was discovered that the mode of test administration (MTA) has no significant main effect on students' academic performance in mathematics { $F(1, 249) = 2.450, p > .05, \text{Partial } \eta^2 = .010$ } based on the perspective of birth order; while birth order has a significant main effect on the academic performance of students in mathematics { $F(3, 249), p < .05, \text{Partial } \eta^2 = .053$ } from the mode of test administration perspective. Firstborns who took the PPT scored lower than firstborns who took the CBT. Middleborns who took the PPT scored higher than middleborns who took the CBT. Lastborns who took the PPT outperformed their counterparts who took the CBT. Lastborns who took the PPT scored lower than lastborns in the CBT category. Generally, students scored lower in PPT than in CBT irrespective of their birth order.

Conclusion

Based on the findings of this study it was concluded that the mode of test administration has a significant role to play in determining the extent to which students perform in mathematics. The birth order of students has no significant impact on the academic performance of students in Mathematics. Students' gender has a significant impact on the academic performance of students with males demonstrating an overall academic performance in Mathematics that is better than females. Generally, it was

concluded that the mode of test administration and birth variables of students has a stake in deciding how students will perform in mathematics.

Recommendations

Based on the conclusion of this study, it was recommended that:

i. The computer-based test should be adopted in secondary schools as the sole means of assessing students' academic performance in mathematics and other subjects. This will help to improve students' academic performance in mathematics and as well, reduce incidences of examination malpractice from the formal school system.

ii. Every parent should take active responsibility in the training, development and education of their children and provide equal opportunities to all of them irrespective of their gender, birth order or both.

iii. Female children, just like their male counterparts, should be treated with respect and should also be seen as having the potentials to contribute to the development of society. Thus, all forms of discrimination of the girl child in the family should be abolished.

iv. The government at all levels should ensure that secondary schools in Nigeria and Cross River State generally, and Obubra Local Government Area specifically, are provided with adequate ICT facilities that will aid in the conduct of computer-based tests. Such ICT facilities include computers (desktops, laptops and notebooks), internet facilities, firewalls, routers, switches, bridges, storage drives, and so on.

v. Secondary school teachers should be trained and/or retrained on how to use these ICT resources to conduct computer-based examinations and how to protect such questions from leakage, viruses, and other internal or external threats that may affect the integrity of such questions as well as the performance of students.

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