

COMPARATIVE ANALYSIS OF STUDENTS' PERFORMANCE IN MATHEMATICS
AMONG THE FOUR SENIOR HIGH SCHOOLS IN BONGO DISTRICT.

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IJASR 2020

VOLUME 3

ISSUE 2 MARCH - APRIL

ISSN: 2581-7876

Abstract – The study paper aims to examine students' performance in mathematics across the four senior schools within the District of Bongo. The research utilized the annual report of students' marks for the WASSCE. The data were collected from the four senior high schools selected in the Bongo District. The data included dates from 2015 through 2018. One way variance analysis was employed to assess the performance of the students in mathematics between the four senior high schools. The findings showed that the performance of mathematics students among the four high schools (A, B, C&D) between 2015 and 2018 was very low. The results also showed that among the four senior high schools within the District, there is no statistically significant difference in the performance of the students in mathematics. The research paper concluded that the performance of students in mathematics across the district's four senior high schools is very low and required the appropriate attention to address the situation within the district.

Keywords: Analysis of Variance, Performance, Students, Mathematics, Grade, requirement, WASSCE

Introduction

That education is essential to a country's economic growth and development is an undeniable fact. It brings in a positive shift to human life. In Ghana, greater focus is placed on the advancement of science and technology, since the two are very significant growth factors. Mathematics, however, is the bedrock of science and technology without which these don't exist. Without a solid mathematical foundation, it is impossible to progress as a country. Science and technology can therefore only progress with the assistance of mathematics.

Mathematical methods pervade nearly every area of human activity and play a significant part in a nation's economic growth. Student success in secondary school mathematics is critical for economic growth as it serves as a resource for academic advancement in a chosen profession as well as a measure to prepare a person for meaningful living. So we need nothing short of good mathematics success at all schooling stages. External assessment level performance (i.e. WASSCE), decides who would pass from one stage to the next cycle of the educational ladder. Students who wish to pursue further studies after high school in Ghana must receive at least one C6 pass in all three core subjects which include; English Language, Core Mathematics and Integrated Science (EMS) and also, at least a grade C6 in any of their elective subjects to enable them do a diploma or degree programme. Sadly, at the end of secondary education students' success in mathematics has not changed for a period of time now.

Because of the poor performance in mathematics, most notably in core mathematics at the West African Senior School Certificate Examinations (WASSCE), many students cannot meet the entry requirements as outlined above each year. Place, for instance, in August 2016, City Fmonline.com performed an overview of the findings of WASSCE released by Rev. NiiNmaiOllenum, Head of the WAEC National Office of Ghana, and made some tragic conclusions. The results of 234,871 candidates were published out of a total of 274,262 candidates who had

sat for the examination that year. Of that total, 77,108 candidates representing 32.83 percent of A1-C6 grade candidates. Aside from that, 65,007 candidates representing 27.68 percent had won grades

D7 – E8 while 42, 529 (18.09 percent) had won F9. In fact, 45.77 percent representing 107,526 candidates failed to meet the criteria for university entry in 2016. WASSCE results for 2017 have revealed that 106,024 (37 percent) of candidates earned grades D7 – E8 that year, while 58,070 (20.27 percent) earned grades F9. This means that 164,094 (57.27%) could not fulfill the university / Agnes T.C July 2017 criteria. Worse performance was reported in 2018 WASSCE results as a total of 193,882 (61.67 percent) candidates were unable to meet the entry criteria in core mathematics.

Now, let's step away from the national outlook to a local (i.e. Bongo local) outlook on the success of the students in mathematics. The district was established in 1988 and has a population size of about 100,000 people.

It has three public high schools, and four SHS / TECH private / community schools. This work is limited to four senior high schools, including the three senior high schools in the city and one high school in the neighborhood.

For confidentiality and anonymity purposes, the researchers recommend using letters A, B, C and D to represent the four schools in question.

How was the success of mathematics students at these four public schools from 2015 through 2018? The researchers provide a detailed answer to the above question by presenting the analysis of the results of WASSCE, especially with regard to mathematics at the four schools in the district

The main qualifications for joining higher institution in Ghana are passing mathematics. Mathematics being an important subject in the academic curriculum, it is then appropriate to research the performance of mathematics students in the four selected high schools in the District of Bongo.

The school results are higher or better yet worse off relative to the national statistics for the school, which means there is something unusual about the district when it comes to student success in WASSCE mathematics. Therefore, this research aims to find out the achievement of the students in mathematics between 2015 and 2018.

RESEARCH METHODS

The research utilized the annual report of students for the WASSCE tests. The data were collected from the four selected senior high schools in the District of Bongo. The data covered periods 2015 through 2018. The data was primarily historic based on the success of the students in mathematics among the four Bongo District Senior High Schools. One way variance analysis was used to compare the performance of the students in mathematics among the four senior high schools in Bongo District.

RESULTS AND ANALYSIS

An exploratory analysis of the performance of students in mathematics for the four consecutive years, using primarily variance analysis (ANOVA). Some computations were made to obtain first the descriptive statistics regarding the performance of the students in mathematics, followed by comparative analysis among the four senior high schools within the district.

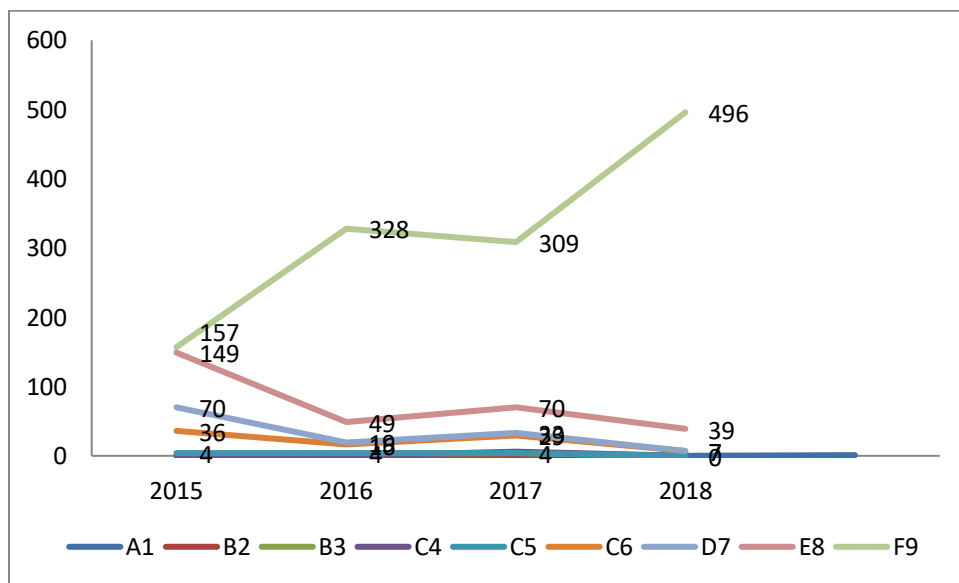
Table 1: Descriptive statistics of students' performance in mathematics

<i>Students' Performance in Mathematics</i>	
Mean	32.68055556
Standard Error	6.144052696
Median	3
Mode	0
Standard Deviation	73.72863235

Sample Variance	5435.911228
Kurtosis	14.87019293
Skewness	3.587142943
Range	496
Minimum	0
Maximum	496
Sum	4706
Count	144
Confidence Level (95.0%)	12.14490103

The minimum performance of students in mathematics was found to be 0 and a maximum of 496 while the average performance was 32.68 with a corresponding standard deviation of 6.14, which suggests that the data is widely distributed around the mean. The 18.79 per cent coefficient of variation also shows that the data has a very high variance. The output of the students in mathematics distribution also indicates a positive skew of 3.59, meaning that most of the scores are clustered to the right of the mean and have a positive kurtosis value of 14.87, also suggesting that the data is platykurtic, has flattened and that many of the students' scores are flattened at either end of the distribution as a result of normal peaks. This means the quality of education within the District have dropped

Figure 1 shows the students' performance mathematics among the four senior high schools in bongo district ranging from 2015 to 2018.



The results of WASSCE in School A in 2015 showed that out of a total of 418 candidates who sat for the exam that year, 41 candidates representing 9.8 percent had earned A1 – C6. A total of 219 candidates (52.39 percent) received grades D7 – E8, 157 (37.56 percent) received F9 and 1 (0.24 percent) did not write the test. Essentially, 376 applicants (89.95 percent) could not meet the criteria for university entry.

The WASSCE results for 2016 showed that 23 (5.49 percent) of the candidates received grades A1 – C6. 68 (16.23 percent) obtained grades D7 – E8 while 328(78.28 percent) obtained F9. In turn, out of a total of 419 applicants, 396 (94.51 per cent) failed to meet the entry criteria in that year. Of a total of 456, in 2017, 44 candidates representing 9.65 percent obtained grades A1 – C6. 103 (22.59%) of the candidates earned grades D7 – E8 while 309 (67.76%) failed flatly. And a total of 412 (90.35 percent) were unable to meet the entry criteria Worst WASSCE results were reported in 2018, as a total of 542 candidates (98.37 percent) failed to meet the criteria for university entry. In reality, 496 (90.02 percent) fell flat while just 7 (1.27 percent) of the candidates went through. The 2016 results also showed that 65 candidates (16.67 percent) earned grades A1– C6. 90 (23.08

percent) got D7 – E8 while 234 (60 percent) got F9. One individual had the outcome cancelled. That year, a total of 390 candidates sat for the exam, out of which 324 (83.08 per cent) did not meet the entry criteria. See table 1 and table 2 below for descriptions of the report.

Table 2: summary results of School A

SUMMARY

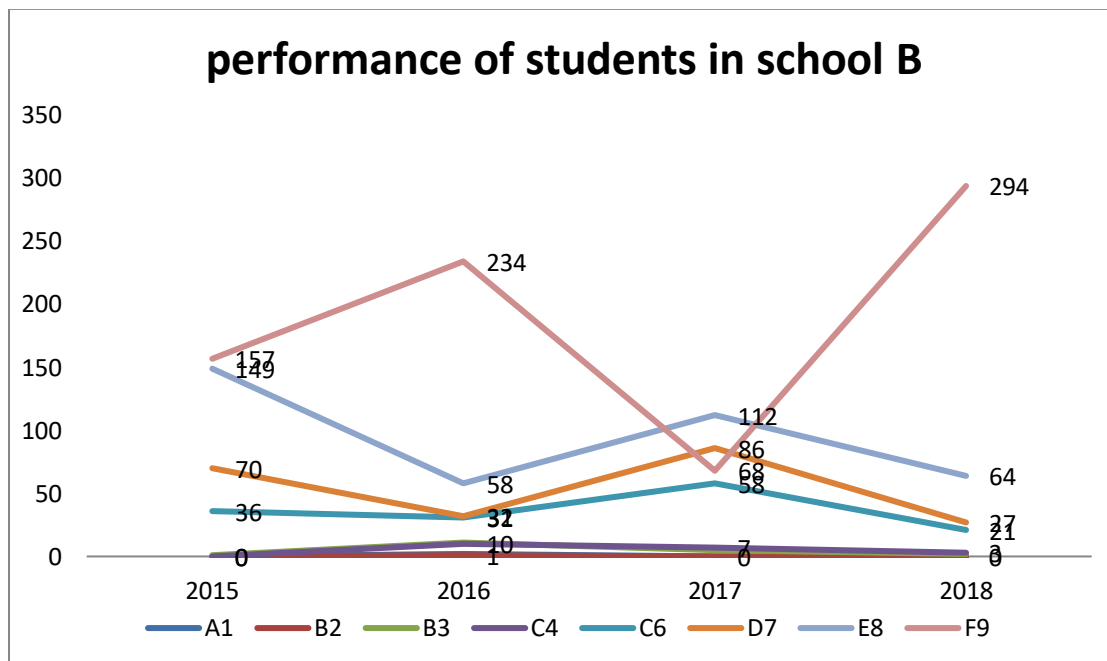
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
A1	4	1	0.25	0.25
B2	4	0	0	0
B3	4	8	2	3.333333
C4	4	6	1.5	9
C5	4	12	3	4
C6	4	88	22	168.6667
D7	4	129	32.25	746.25
E8	4	307	76.75	2486.917
F9	4	1290	322.5	19235

Table2:ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	351598.1	8	43949.76	17.46085	8.05E-09	2.305313
Within Groups	67960.25	27	2517.046			
Total	419558.3	35				

From table 2 and table 3 it is clear that there is a statistically significant decrease in students’ performance in mathematics between 2015 to2018. This implies over 2000 students were not able gain admission into tertiary institution which affect the nearby tertiary institution in the municipality especially Bolgatanga polytechnic.

Figure 2: shows the students' performance in mathematics between 2015-2018 by School B.



The WASSCE results in 2017 for school B were somehow better compared to the previous year. A total of 344 candidates sat for the examination that year. Out of this, 78(22.67%) of the candidates obtained grades A1 – C6. 198 (57.56%) obtained grades D7 – E8 whilst 68 (19.77%) obtained grades F9. This implies, a total of 266 (77.33%) could not meet the entry requirements.

Worst results were recorded in 2018, where out of a total of 418 candidates, 385(92.11%) failed to meet the entry requirements. Indeed, 294(70.33%) failed flat. Only 33 (7.89%) of the candidates passed that year. For school C, the WASSCE results in 2015 indicated that only one candidate representing 0.53% obtained grades A1 – C6. 17 (8.99%) of the candidates obtained grades D7 – E8 whereas 171(90.48%) could not meet the entry requirements.

The WASSCE results for 2016 also indicated that 48 (16.49%) of the candidates obtained grades A1 – C6. 211 candidates representing 72.51% obtained grades D7 – E8 whilst 32 (11%) obtained F9. In all, 243 (83.51%) failed to meet the entry requirements. It is worth mentioning that 291 candidates sat for the examination that year. For 2017, a total of 317 candidates sat for the examination of which no candidate had obtained grades A1 – C6. 27 candidates representing 8.52% obtained grades D7 – E8 whereas 286 (90.22%) obtained F9. 3 candidates results were withheld whilst 1 person had the results cancelled. In fact, 313 (98.74%) of the candidates failed to meet the entry requirements. Details of the results analysis are shown in table 3 and table 4 below.

Table 4: summary of the results of School B

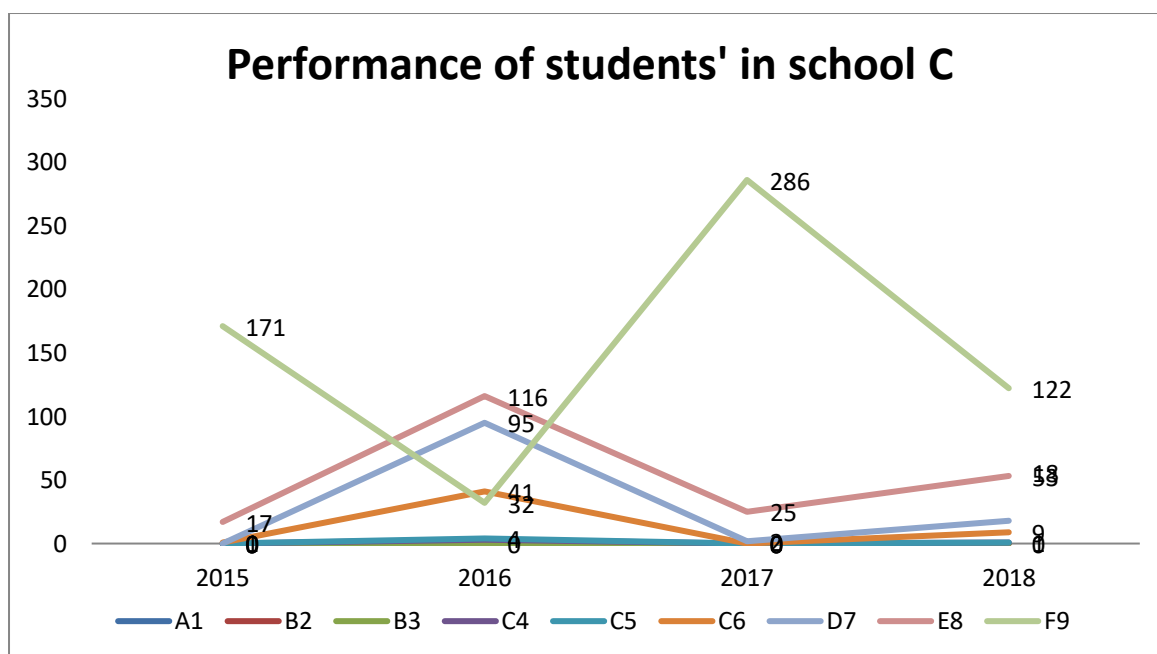
Groups	Count	Sum	Average	Variance
A1	4	2	0.5	1
B2	4	1	0.25	0.25
B3	4	19	4.75	20.25
C4	4	20	5	19.33333
C5	4	29	7.25	6.25
C6	4	146	36.5	244.3333
D7	4	215	53.75	830.9167
E8	4	383	95.75	1844.25
F9	4	753	188.25	9570.917

Table 5: ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	127416.4	8	15927.05	11.43318	6.47E-07	2.305313
Within Groups	37612.5	27	1393.056			
Total	165028.9	35				

From table 4 and table 5, it is clear that there is a significant decrease in students' performance in mathematics with respect to school B. this implies over 1000 student of the school B could not gain admission into the tertiary institutions between 2015 to 2018.

Figure 4: shows the students' performance in mathematics between 2015-2018 by School C.



For school C, the WASSCE results in 2015 indicated that only one candidate representing 0.53% obtained grades A1 – C6. 17 (8.99%) of the candidates obtained grades D7 – E8 whereas 171(90.48%) could not meet the entry requirements.

The WASSCE results for 2016 also indicated that 48 (16.49%) of the candidates obtained grades A1 – C6. 211 candidates representing 72.51% obtained grades D7 – E8 whilst 32 (11%) obtained F9. In all, 243 (83.51%) failed to meet the entry requirements. It is worth mentioning that 291 candidates sat for the examination that year. For 2017, a total of 317 candidates sat for the examination of which no candidate had obtained grades A1 – C6. 27 candidates representing 8.52% obtained grades D7 – E8 whereas 286 (90.22%) obtained F9. 3 candidates results were withheld whilst 1 person had the results cancelled. In fact, 313 (98.74%) of the candidates failed to meet the entry requirements.

The WASSCE results for 2018 indicated that 11(5.39%) of the candidates obtained grades A1 – C6 whereas 71(34.80%) obtain grades D7 – E8. Indeed, 122(59.80%) failed flat and the number of candidates who could not meet entry requirements were 193 (94.61%). 204 candidates have actually sat for the examination that year. The WASSCE results for school D in 2015 indicated that 1 (1.52%) of the candidates obtained grades A1 – C6. 26 (39.39%) obtain D7 – E8 whereas 39 (39.09%) obtain F9. In all 66 candidates sat for the examination that year and 65(98.48%) could not meet entry requirements. Details of the analysis are shown in table 5 and table 6

Table 6: Summary results of School C

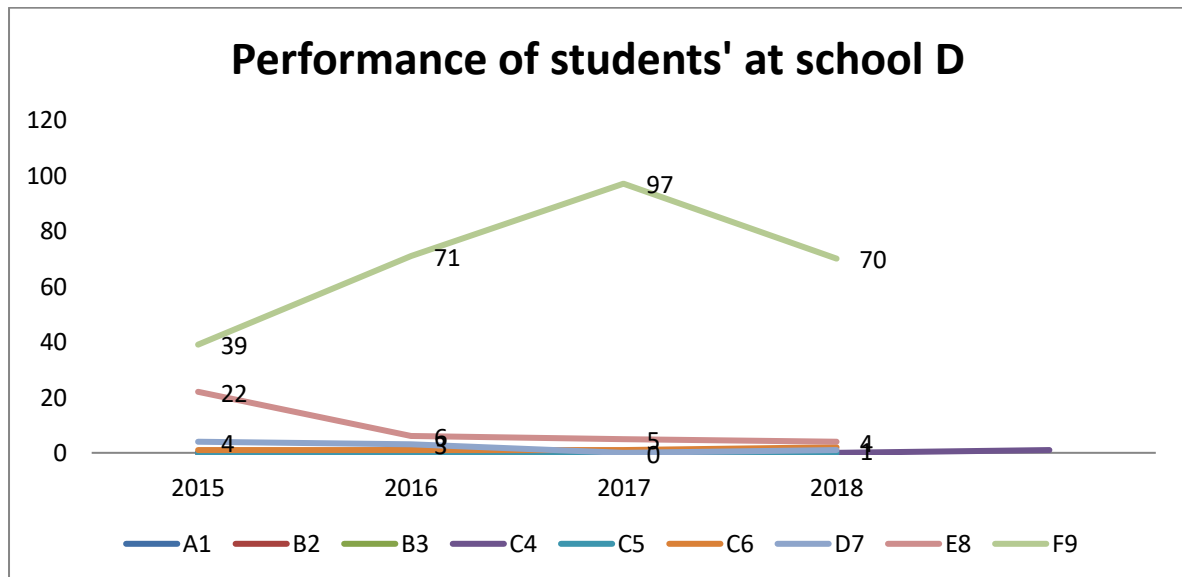
SUMMARY				
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
A1	4	0	0	0
B2	4	0	0	0
B3	4	0	0	0
C4	4	4	1	2
C5	4	5	1.25	3.583333
C6	4	51	12.75	370.9167
D7	4	115	28.75	2015.583
E8	4	211	52.75	2016.25
F9	4	611	152.75	11204.92

Table 7: ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	80815.89	8	10101.99	5.823123	0.000234	2.305313
Within Groups	46839.75	27	1734.806			
Total	127655.6	35				

From table 6 and table 7 shows that there is a statistical significant decrease in students’ performance in mathematics with respect to school C. this implies that over 700 students could not gain admission into the tertiary institution.

Figure 5 shows the students’ performance in mathematics between 2015-2018 by School D.



The WASSCE results for 2016 were no different. Out of a total of 82 candidates who sat for the examination, 2 (2.44%) obtain grades A1 – C6. 9 (10.98%) of the candidates obtain grades D7 – E8 whereas 71 (86.59%) obtain F9. In fact, 80 (97.56%) failed to meet the entry requirements.

The worst WASSCE results for school D was recorded in 2017 where out of a total of 103 candidates, 1 (0.97%) obtain grades A1 – C6. 5 (4.85%) of the candidates obtain grades D7 – E8 whereas 97 (94.17%) obtain F9. Thus, a total of 102 (99.03%) could not meet the entry requirements. The WASSCE results in 2018 also indicated that 2 (2.60%) of the candidates obtain grades A1 – C6. 5 (6.49%) obtain grades D7 – E8 whilst 70 (90.91%) failed flat. This implies, 75 (97.4%) of the candidates could not meet the entry requirements. A total of 77 candidates sat for the examination that year. Details of the analysis are shown in table 7 and table 8.

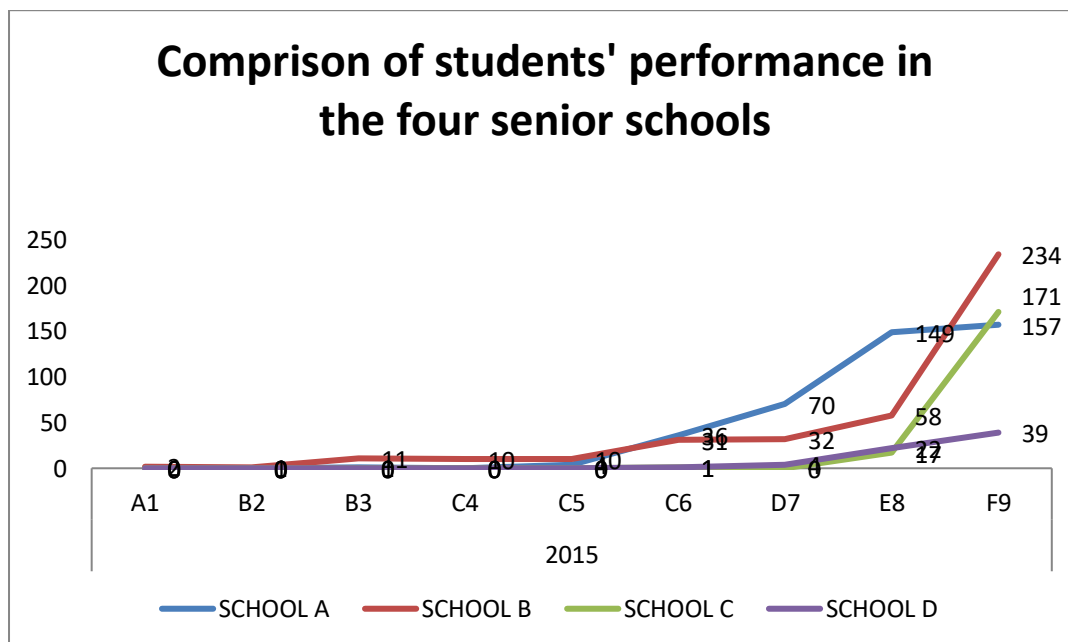
Table 8: summary results of School D

Groups	Count	Sum	Average	Variance
A1	4	0	0	0
B2	4	0	0	0
B3	4	0	0	0
C4	4	1	0.25	0.25
C5	4	0	0	0
C6	4	5	1.25	0.25
D7	4	8	2	3.333333
E8	4	37	9.25	72.91667
F9	4	277	69.25	562.9167

Table 9: ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	16558.56	8	2069.819	29.122	2.4E-11	2.305313
Within Groups	1919	27	71.07407			
Total	18477.56	35				

From table 8 and table 9 shows that there is a statistical significant decrease in students' performance in mathematics. This implies students' performance with respect to school D is very poor between 2015 to 2018.



It is clear from the figure the performance of the students among the four senior schools are closely related with respect 2015. This implies that there no significant performance of students among the four senior high schools within the district. Details of the analysis are shown in table 9 and table 10

Table 10: summary results of the four senior high schools

Groups	Count	Sum	Average	Variance
SCHOOL A	9	417	46.33333	4217.75
SCHOOL B	9	389	43.22222	5452.194
SCHOOL C	9	189	21	3195.25
SCHOOL D	9	66	7.333333	192.25

Table 11:ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	9317.417	3	3105.806	0.951428	0.427474	2.90112
Within Groups	104459.6	32	3264.361			
Total	113777	35				

Table 10 and table 11 indicated that there is no significant difference of students' performance among the four senior schools. This implies that the average scores of the students' performance among the four senior are closely related as indicated by the p-value =0.427474.

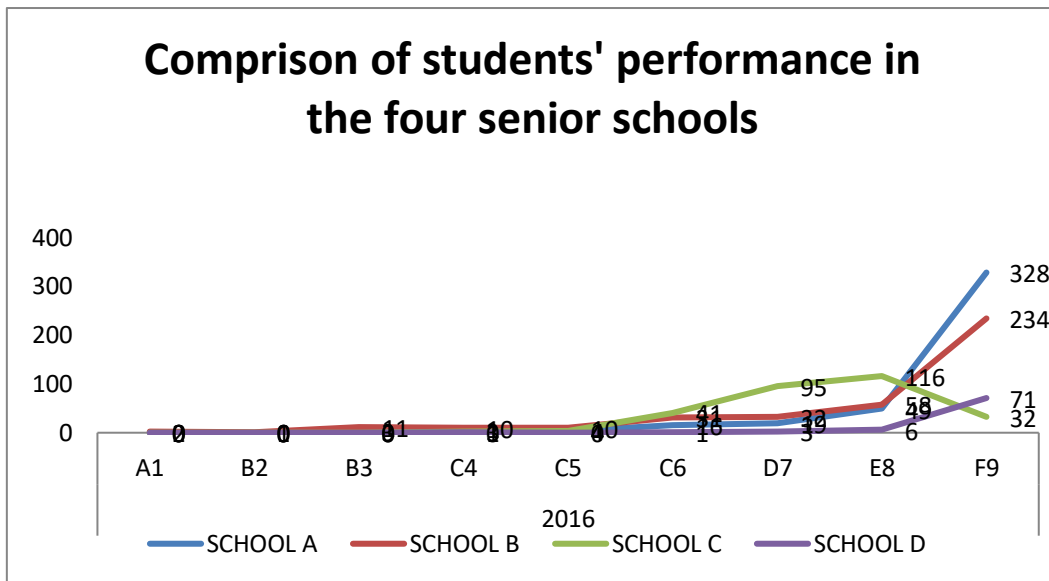


Table 12: SUMMARY

Groups	Count	Sum	Average	Variance
SCHOOL A	9	419	46.55556	11390.03
SCHOOL B	9	389	43.22222	5452.194
SCHOOL C	9	291	32.33333	1975.25
SCHOOL D	9	82	9.111111	542.6111

Table13:ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	7732.972	3	2577.657	0.532572	0.663237	2.90112
Within Groups	154880.7	32	4840.021			
Total	162613.6	35				

Comparing the performance of the students among the four senior high schools with respect to 2016. It is clear from table 12, table 13 and figure 6 that there is no statistically significant difference in students performance among the four senior schools within the bongo district as indicated by the p-value=0.663237. This implies that the student's performance among the four senior high schools is the same with respect to the year 2016.

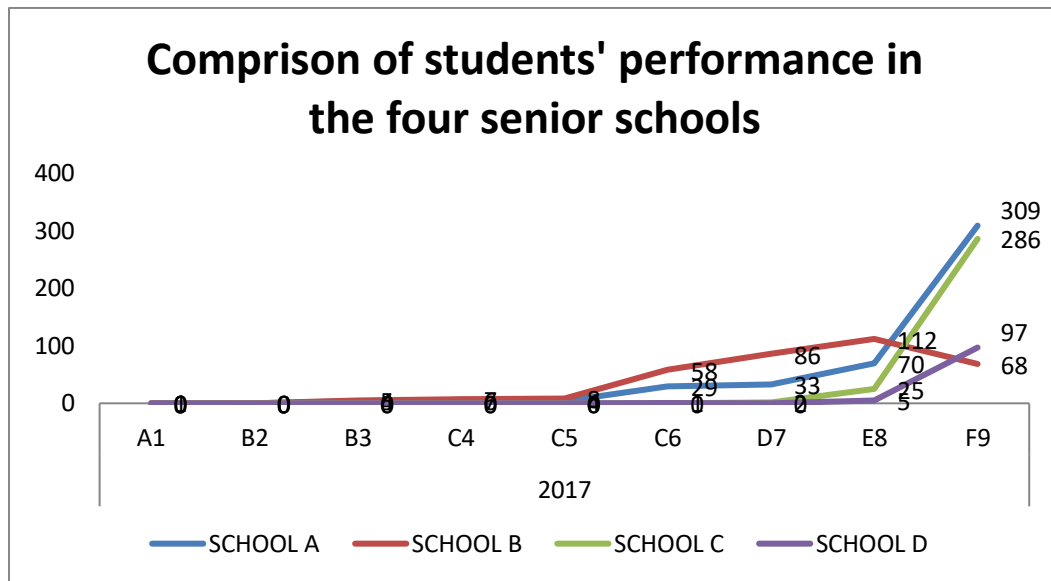


Table 14:SUMMARY

Groups	Count	Sum	Average	Variance
SCHOOL A	9	456	50.66667	9909.5
SCHOOL B	9	344	38.22222	1864.694
SCHOOL C	9	313	34.77778	8942.444
SCHOOL D	9	103	11.44444	1032.028

Table15:ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	7242.889	3	2414.296	0.444036	0.723161	2.90112
Within Groups	173989.3	32	5437.167			
Total	181232.2	35				

From table 14, table 15 and figure 6 shows that there is no significant difference in the performance of students in mathematics among the four senior high schools with respect to the year 2017.

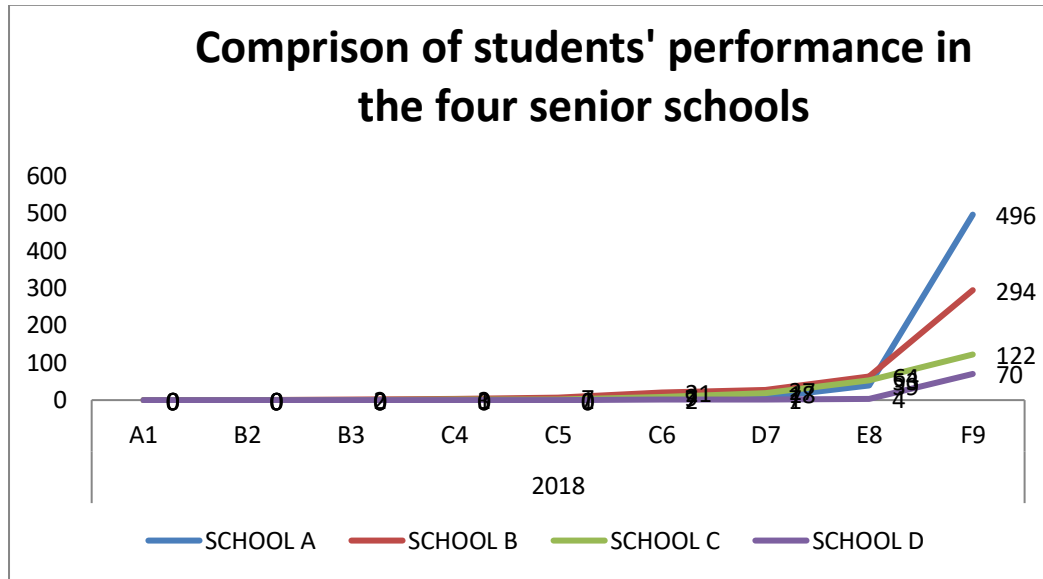


Table 16: SUMMARY

Groups	Count	Sum	Average	Variance
SCHOOL A	9	549	61	26768.25
SCHOOL B	9	418	46.444444	9043.778
SCHOOL C	9	204	22.666667	1684.5
SCHOOL D	9	77	8.555556	532.7778

Table17:ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	14921.56	3	4973.852	0.52316	0.669466	2.90112
Within Groups	304234.4	32	9507.326			
Total	319156	35				

The researchers again compared the performance of students in mathematics among the four senior high schools with respect to the year 2018. It is clearly shows that there is no significant difference of the students' performance among the four senior high schools with respect to 2018. Details of the analysis are indicated in the table 16, table 17 and figure 7

Summary of the results

The finding revealed that the minimum students' performance in mathematics was found to be 0 and maximum 496 whilst the average performance was 32.68 with accompanying standard deviation of 6.14, indicating that the data is widely dispersed across the mean. The coefficient of variation of 18.79% also shows that the data has a very high variance. The students' performance in mathematics distribution also exhibits positive skewness of 3.59 indicating that most of the scores are concentrated to the right of the mean and has a positive kurtosis value of 14.87 also indicating that the data is platykurtic, thus, has a flattened and there are many of the students' scores at

either extreme of the distribution hence flattened than normal peak. This implies the standards of secondary education within the bongo district have fallen.

The findings indicated that the performance of students in mathematics among the four senior schools (A, B, C&D) is very bad for the period between 2015 to 2018.

The findings also revealed that there is no statistically significant difference of the students' performance in mathematics among the four senior high schools within the district. This implies that the performance of students in mathematics across the four senior high schools remains the same throughout the study period and this suggest that more needs to done in order to resolved the situation at stake.

Conclusion

The research paper concluded that students' performance in mathematics across the four senior high schools within the district are very poor which implies that many of the students are not able gain admission into the tertiary institution thereby leading to low enrolment in the tertiary institution within the catchment area.

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