

Statistical Treatment of Student-Teacher Ratio as a Measure of Academic Performance in Mathematics for African Development

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Abstract

Over the years, perennial problem of classroom congestion, poverty level and low classroom utilization rates in Nigeria worsen the teaching and learning of Mathematics. This paper investigates the student-teacher ratio as yardstick for students' performance in Mathematics in Junior Secondary School Certificate Examination (JSSCE). The enrolment of students, the numbers of teachers, together with students' performances in Mathematics were sampled from four schools for a period of four years. Two of the schools have an average student-teacher ratio of (50:1), with performance average of (33% - 45%) and standard deviation (11.21); while the other two have average student-teacher ratio of (18:1) with performance average of (60% - 77%) and standard deviation of (8.43). Some statistical tools like standard deviation and T-test were used to test the Null hypothesis. At significant level (0.05) and degree of freedom (14), the t-value was 0.0000517, while the p-value was 0.999922. The results of the findings show that there was significant difference in student-teacher ratio and their performance in Mathematics, and invariably, may be among the factors that account for the credible performance accounted for in the private secondary schools as against their public counterpart. The result suggested that more teachers should be hired in order to decrease the number of students per teacher so that students' achievement can be enhanced and hence, brings about National Development.

Keywords: *Student-teacher ratio, Students' academic performance, National Development*

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Background to the Study

In most countries of the world, the pride of institutions of learning depends not just on the quantity but more importantly on the quality of the product at all levels. However, policy makers in some developing countries are to target the quality of education performance as an immediate priority. In particular, cognizance is being taken of the argument that the provision of student and teacher of high quality should be given top priority and that ultimately, the success of any educational system depends largely on the quality of the teacher (Dave, 2008).

Most of the governments of the world spend a significant amount of their budget on resource inputs in the education sector. They make decisions about providing resource inputs to enhance student achievement and performance. Moreover, not all these decisions are easy to take; especially in the third world countries where mismanagement makes the problem more adverse. To reduce the scope for mistakes, the true picture of the determinants of education outcome is desirable. Resource inputs have a vital role in the education process. Student achievement at any point is a cumulative function of the current and the prior resource inputs such as family, peers' effect and institutional resource inputs. However, all these factors are outside the direct control of an educationist. Therefore, an educationist directly deals with and controls the school specific resource inputs.

The poor funding of education in most third world countries does not enable the school system to have manageable class sizes, adequate student classroom space and appropriate class utilization rates. In spite of the fact that these factors determine the productivity of teachers and students' academic performance, governments do not show adequate concern about the deterioration in the standard of education in the countries (Kezar, 2006).

Every formal education setting involves students-teacher relationship. The nomenclature of the teacher depends on the model of interaction. According to Davis (2002), teachers can be described as a tutor if he gives private lessons to one student or a small group and he is directly paid by them. He is called a director (rector) if he gives instruction to the learners on how to go about the learning process. He is described as a monitor if he observes how the student is learning, and he is called a supervisor if he oversees the students learning activity. The nature of the subject also has a part to play in determining the effect of the teacher-student ratio. If the subject is basically theoretical; or basically practical or both; the ratio will not be the same in all the cases.

Over the years, perennial problem of classroom congestion, poverty level and low classroom utilization rates in Nigeria worsen the situation of education. Education in the country is poorly funded, hence most of the public schools' experience classroom congestion, low students-classroom-space and low classroom utilization rates; hence these situations may likely affect students' academic performance adversely. The large number of students passing through the system in Nigeria is a serious problem, particularly with the state government's inability to provide adequate furnished equipment. The few schools that have enough teaching staff, at times have low classroom utilization rates, perhaps because of poor supervision. This situation does not favor academic learning (Dave, 2008).

Students' achievement in any teaching and learning situation is very important. Unfortunately, students' performance in secondary schools in Nigeria has not been very encouraging as consistently highlighted by the moderators and chief Examiners reports and WAEC and NECO results for past decade. Academic achievement is one of the leading goals and big challenge for an educational system.

According to Cuban (2004), class-size and student-teacher ratio has a great impact on the quality of education and academic success of students. There is no doubt that pupil-teacher ratio and per-student outgoings are some of the important resource inputs for any academic institution. Lesser the ratio of student and teacher in the class better is the probability of improving the quality of education and accomplishing the academic goals of institutions. Quality of education is very crucial for strategic planning of academic goals and tag along with the pace of developed world. However, the problem at stake is whether student-teacher ratio has any implication for the quality of education.

Taft, Perkowski and Martin (2011), found out that, there is a clear and strong relationship between class size, student-teacher ratio and students' achievement. Also that, students learned more in small classes. They further revealed that, the major benefit of reducing class size occurred where the number of students in the class was fewer than 20. Finally, they concluded that small classes were superior in terms of students' reactions, teachers' morale and quality of the instructional environment.

Based on the foregoing, there is a need to examine the factors that affect academic performance of students. Among some to the factors of academic performance according to various researchers include teaching methods (Ahmed and Abimbola, 2011), use of instructional materials (Adalikwu and Iorkpilgh, 2012), socio-economic background, family support, intellectual aptitude of student, personality of student, self-confidence, and previous instructional quality have been found to also influence students' performance (Dunkin and Biddle (2004) to mention just a few. This paper is aimed at examining the effect of student-teacher ratio on students' academic performance in Junior Secondary Schools in Kwami Local Government Area of Gombe state; which invariably lead to National Development.

Theoretical Framework

This study will be based on system theory. A general system concept is a functional analysis of all the sub-units interacting and interrelating to function as a whole system. It is a functional analysis of sub-systems which seeks to explain the character of the system as a whole. Synergy is one of the aspects of system concept; it is a collective effort that is more than a single effort. The expression of synergistic function connotes a derive demand function where its sub-units of the system is dependent on one another to function.

A system is any ordered interrelated set of things and their attributes, linked by flow of energy and matter, as distinct from the surrounding environment outside the system. The elements within a system may be arranged in a series or interwoven with one another. A system comprised any number of subsystems (Yoon and Kuchinke 2005). Within Earth's systems, both matter and energy are stored and retrieved, and energy is transformed from one type to

another. Specifically, the systematic approach to school as a formal organization sees the organization as a purposeful system composed of interactive parts, rather than dealing separately, the approach gives the administrators the opportunities to look at the various components of the organization in a large external environment working together towards a predefined objectives. Therefore, system theory is the best to describe the school as a formal organization via student-teacher relationship.

Studies on Students-Teachers Ratio

Class factors are very important in the teaching-learning activities, particularly when students' academic performance is being considered. Class size is an important factor in relation to academic performance of students. There is a consensus among various researchers and educationists that, the lower the class size or teacher-students' ratio, since students' achievement decreases as class size increases. Kezar (2006) described student-teacher ratio as a tool that can be used to measure performance of the education system. A lot of argument has occurred on the impact of 21st century student-teacher ratio on students' performance, The National policy on Education (2004) recommended that the teacher-students ratio should be 1:30. In emphasizing the importance of class size to the learning/teaching process, the All Nigeria Conference of Principals of Secondary Schools (ANCOPSS, 2002) recommended a maximum of forty students per class for effective management and better control.

A recent study by Addonizio and Phelps (2000), reported that there is positive relationship between certain variables such as class size, teacher-student ratio, students factors and performance in examination. They were discovered to be factors that have direct influence on academic performance of schools. Schools with larger class size and high teachers-students ratio recorded poor performance while better academic performance is associated with schools with small size and lower teacher-students ratio. This was supported by (Duflo, Dupas, and Kremer 2007). Other studies like Blatchford, Goldstein, and Mortimore (1998), Cooper (1998), Bozzomo and Rouse (2001), confirm that there was no relationship between the size of the class and the results.

The Influence of Student-Teacher Ratio on Quality of Learning

According to Akinsolu (2010), it is very easy for teachers to evaluate, educate and get positive feedback if class-size is small and number of students in class is very less. Most of the experts consider that lower student-teacher ratio or "student teacher ratio" give better upshots in contrast to higher student-teacher ratio. In many cases, higher student-teacher ratio outcome brings in high score. In general, student-teacher ratio plays a decisive role in augmenting the quality of education. Actual class-size may be quite larger than the pupil-teacher ratio due to absenteeism and specialism of teachers.

Purpose of the Study

The problem of poor performance is apparently assuming a dimension that could affect the entire situation in the country. Nevertheless, there are many factors that affect student achievement, but the purpose of this paper is to explore and analyze the effects of student-teacher ratio as well as student-teacher interaction dynamics at the secondary school level as a determinant of students' academic achievement.

The paper is meant to:

1. Identify student enrolment and numbers of teachers for calculating student teacher ratios and class sizes.
2. Identify the relationship (association) between the independent variables i.e. student teacher ratio and class size, and the dependent variable academic achievement.
3. Find out whether student-teacher ratio influences Junior Secondary School Students' Performance in Kwami Local Government Area of Gombe State.
4. Identify some guiding principles towards optimal learning outcome which can bring about National Development.

Research Questions

This research will provide answers to the following questions:

- (i) What is the number of students enrolled and number of teachers in the selected Junior Secondary Schools in Kwami Local Government Area?
- (ii) Is there any relationship (association) between the independent variable i.e, student-teacher ratio and class size, and the dependent variable academic achievement?
- (iii) To what extent does student-teacher ratio and class size influence Junior Secondary Students academic performance in Kwami Local Government Area of Gombe State?
- (iii) What are the alleviating measures for combating the problems identified in this study?

Research Hypothesis

In order to identify the variables and to accomplish the purpose of this study, the following hypotheses were postulated in null form for the purpose of this study:

- H_{01} - There is no significant difference in performance of students in schools with low students-teacher ratio and students in schools with high students' teacher ratio.
- H_{02} - There is significant difference in performance of students in schools with low students-teacher ratio and students in schools with high students' teacher ratio.

Research Methodology

Research Design

This study is theoretical because it involves the collection of secondary data from exams records of the selected schools for analysis in the research.

Population of the study

The population of the study comprised of all Junior Secondary School students in public schools in Kwami Local Government Area of Gombe State. There are 28 public Junior Secondary Schools in Kwami Local Government. (Gombe State Ministry of Education, 2019).

Sample and Sampling Technique

This study makes use of intact class so as to assess the influence of student-teacher ratio on students' academic performance in Kwami Local Government Area of Gombe state.

Research Instrument

The data was collected directly from the exams records of the selected schools based on the needs of the research.

Method of Data Collection

The method of data collection in this study will involve the gathering of information and data through both primary and secondary sources. The primary data are gathered from the inventory/intact class, and the secondary data are derived from the JSCE results.

Procedure for Data Analysis

The findings of this research were analyzed quantitatively using t-test analysis. Also, the responses obtained from the oral interview conducted was subjected to the appropriate statistical test to provide answers to the research questions and to test the research hypotheses in order to investigate the relationship between students-teacher ratio and students' academic performance.

Data Analysis and Interpretation of Result

The results obtained from the field work of the study are displayed. The information was gathered through secondary data (JSCE results) and oral interview conducted for the teachers and students in the selected secondary schools. The results of the schools were gotten from the school's records which contained the detailed result of 2015 to 2018, and the results were analyzed.

Data Presentation and Discussion

Research Question 1: What is the number of students enrolled and number of teachers in the selected Junior Secondary Schools in Kwami Local Government Area?

Table 1: A table showing students' enrolment (JSS 1 to JSS 3) and staff strength in each sample schools for the year 2018

Schools	Number of Students Enrolled	Number of Teachers in the School	Students – Teacher Ratio
A	995	35	57:1
B	225	15	15:1
C	378	18	21:1
D	759	15	51:1

The enrolment of student and staff strength in each sample schools are presented in table 1 above. It reveals that school A has 995 students and 35 teachers with 57:1 student - teacher ratio, school B has 225 students and 15 teachers with 15:1 students-teachers ratio, school C has 378 students and 18 teachers with 21:1 student's teacher ratio; and school D has 759 students and 15 teachers with 51:1 students teacher ratio.

Table 2: A table showing students' enrolment (JSS 1 to JSS 3) and staff strength in each sample schools for the year 2017

Schools	Number of Students Enrolled	Number of Teachers in the School	Students – Teacher Ratio
A	899	35	54:1
B	234	15	15:1
C	365	18	21:1
D	760	15	51:1

The enrolment of student and staff strength in each sample schools are presented in table 2 above. It reveals that school A has 899 students and 35 teachers with 54:1 students - teachers ratio, school B has 234 students and 15 teachers with 15:1 students teacher ratio, school C has 355 students and 18 teachers with 21:1 students teacher ratio; and school D has 760 students and 15 teachers with 51:1 students teacher ratio.

Table 3: A table showing students' enrolment (JSS 1 to JSS 3) and staff strength in each sample schools for the year 2016

Schools	Number of Students Enrolled	Number of Teachers in the School	Students – Teacher Ratio
A	897	35	54:1
B	228	15	15:1
C	349	18	21:1
D	762	15	52:1

The enrolment of student and staff strength in each sample schools are presented in table 3 above. It reveals that school A has 897 students and 35 teachers with 54:1 students' teacher ratio, school B has 228 students and 15 teachers with 15:1 student-teacher ratio, school C has 349 students and 18 teachers with 21:1 student - teacher ratio; and school D has 762 students and 15 teachers with 52:1 student-teacher ratio.

Table 4: A table showing students' enrolment (JSS 1 to JSS 3) and staff strength in each sample schools for the year 2015

Schools	Number of Students Enrolled	Number of Teachers in the School	Students – Teacher Ratio
A	884	35	52:1
B	222	15	15:1
C	339	18	21:1
D	695	16	50:1

The enrolment of student and staff strength in each sample schools for the year 2015 is presented in table 4 above. It reveals that school A has 884 students and 33 teachers with 52:1 students' teacher ratio, school B has 222 students and 15 teachers with 15:1 student - teacher ratio, school C has 339 students and 18 teachers with 21:1 student - teacher ratio; and school D has 695 students and 15 teachers with 50:1 student - teacher ratio.

Analysis of JSCE Result of the Schools from 2015- 2018

Table 5: Analysis of Result of School A

Year	No of Candidates	No of A – C Scores	% of A - C	No of D - F	% of D - F	% Total
2015	98	31	31.63	67	68.37	100
2016	111	31	27.93	80	72.07	100
2017	130	38	29.23	92	70.77	100
2018	126	58	46.03	68	53.97	100

Table 5 above shows that 98 students sat for Junior School Certificate Examination in school A in the year 2015, out of which 31 students representing (31.6%) of the students scored between Credit and Distinction, while 67 students representing (68.4%) of the students scored below credit passes and fails. In 2016, 111 students sat for the JSCE, out of which 31 students (i.e 27.9%) of the students scored between Credit and Distinction, while 80 students representing (72.1%) of the students scored below credit passes fails. In 2017, 130 students sat for the JSCE, out of which 38 students (29.2%) of the students scored between Credit and Distinction, while 92 students representing (70.8%) of the students scored below credit passes and fails.

Also, 126 students sat for 2018 JSCE, out of which 58 students (46.0%) of the students scored between Credit and Distinction, while 68 students representing (54.0%) of the students scored below credit passes and fails. However, this implies that the number of students that failed is more than those that scored between credits and distinctions in all the years.

Table 6: Analysis of Result of School B

Year	No of Candidates	No of A – C Scores	% of A - C	No of D - F	% of D - F	% Total
2015	85	49	57.65	36	42.35	100
2016	75	42	56.00	33	44.00	100
2017	78	48	61.54	30	38.46	100
2018	89	58	65.17	31	34.83	100

Table 6 above shows that 85 students sat for Junior School Certificate Examination in school B in the year 2015, out of which 49 students representing (57.6%) of the students scored between Credit and Distinction, while 36 students representing (42.4%) of the students scored below credit passes and fails. In 2016, 75 students sat for the JSCE, out of which 42 students (i.e 56%) of the students scored between Credit and Distinction, while 33 students representing (44%) of the students scored below credit passes fails. In 2017, 78 students sat for the JSCE, out of which 48 students (61.5%) of the students scored between Credit and Distinction, while 30 students representing (38.5%) of the students scored below credit passes and fails.

Again, 89 students sat for 2018 JSCE, out of which 58 students (65.2%) of the students scored between Credit and Distinction, while 31 students representing (34.8%) of the students scored below credit passes and fails. This implies that the number of students that passed with good grades is more than those that scored below credit in all the years.

Table 7: Analysis of Result of School C

Year	No of Candidates	No of A – C Scores	% of A - C	No of D - F	% of D - F	% Total
2015	65	46	70.77	19	29.23	100
2016	62	42	67.74	20	32.26	100
2017	59	48	81.36	11	18.64	100
2018	66	58	87.88	8	12.12	100

Table 7 above shows that 65 students sat for Junior School Certificate Examination in school C in the year 2015, out of which 46 students representing (70.8%) of the students scored between Credit and Distinction, while 19 students representing (29.2%) of the students scored below credit passes and fails. In 2016, 62 students sat for the JSCE, out of which 42 students (i.e.67.7%) of the students scored between Credit and Distinction, while 20 students representing (32.3%) of the students scored below credit passes fails. In 2017, 59 students sat for the JSCE, out of which 48 students (81.4%) of the students scored between Credit and Distinction, while 11 students representing (18.6%) of the students scored below credit passes and fails.

More-so, 66 students sat for 2018 JSCE, out of which 58 students (87.9%) of the students scored between Credit and Distinction, while 8 students representing (12.1%) of the students scored below credit passes and fails. This implies that the number of students that passed with good grades is by far more than those that scored below credit in all the years.

Table 8: Analysis of Result of School D

Year	No of Candidates	No of A – C Scores	% of A - C	No of D - F	% of D - F	% Total
2015	120	51	42.50	69	57.50	100
2016	127	53	41.73	74	58.23	100
2017	129	60	46.51	69	53.49	100
2018	99	48	48.48	51	51.52	100

Table 8 above shows that 120 students sat for Junior School Certificate Examination in school D in the year 2015, out of which 51 students representing (42.5%) of the students scored between Credit and Distinction, while 69 students representing (57.5%) of the students scored below credit passes and fails. In 2016, 127 students sat for the JSCE, out of which 53 students (i.e.41.7%) of the students scored between Credit and Distinction, while 74 students representing (58.3%) of the students scored below credit passes fails. In 2017, 129 students sat for the JSCE, out of which 60 students (46.5%) of the students scored between Credit and Distinction, while 69 students representing (53.5%) of the students scored below credit passes and fails.

Finally, 99 students sat for 2018 JSCE, out of which 48 students (i.e. 48.5%) of the students scored between Credit and Distinction, while 51 students representing (51.5%) of the students scored below credit passes and fails. This implies that the number of students that failed is more than those that scored below credit in all the years.

Table 9: Mean and Standard Deviation Analysis of Percentage of A to C grades of school B & C and A & D

Group	N	Mean	S.D	Mean Diff
A – C Grades of School B & C	8	68.512	11.21	29.2560
A – C Grades of School A & D	8	39.256	8.344	

Significant Level at 0.05

Table 9 above revealed that the percentage of A to C grades of school B and C has a mean score of 68.51, while the percentage of A to C grades of school A and D has a mean score of 39.26. The difference in percentage mean score is 29.26. This indicates that the schools B and C performed better than schools A and D in the JSCE. To establish if the difference is statistically significant or not, some statistical tools like standard deviation and T-test were used to test the Null hypothesis.

Table 10: T-Test Analysis of Percentage of A to C grades of school B & C and A & D

Group	N	Mean	S.D	df	t	P
A – C Grades of School B & C	8	68.5125	11.213	14	0.0000517	0.999922
A – C Grades of School A & D	8	39.2565	8.3438			

Significant Level at 0.05

From Table 10 above, the result showed that p-value is 0.999922 which is greater than the alpha value (significant level) of 0.05 at degree of freedom (df)14. Since the p-value is greater than the alpha value, it indicates that there is a significant difference. Therefore, the null hypothesis H_{01} , which states that there is no significant difference in performance of students in schools with low students-teacher ratio and students in schools with high students' teacher ratio is rejected. Hence, the alternative hypothesis H_{02} which states that there is significant difference in performance of students in schools with low students-teacher ratio and students in schools with high students' teacher ratio is accepted.

Discussion of Findings

Based on the data above, it is evident that student teacher ratio may be among the factors that account for the credible performance accounted for in the private secondary schools against their public counterpart. No wonder, The National Policy on Education (2004) stated that student teacher-ratio should be put at 30:1, and this policy was backed up by UNESCO Policy on education to meet international practices. Following the results of various researches relating to students-teacher ratio we can easily conclude that reducing the class size is not cost effective, but it brings about quality teaching and learning.

Academic improvement is better and more effectively achieved through improving the teacher training and increasing academic rigor in the classroom as teachers' effectiveness is one of the major determinant of student academic performance. However, for the school system to have manageable class sizes, adequate student classroom space and appropriate class utilization rates, the role of both government and non-governmental organization in funding the system is a necessity. Since these factors determine the productivity of teachers and students' academic performance.

Conclusion

The study shows that a class with low student-teacher ratio is the most beneficial setting for a classroom. Therefore, educators and school administrators can focus on finding ways to minimize the student-teacher ratio and look for methods of encouraging both teachers and students towards effective teaching and optimal learning.

Recommendations

Based on the findings of this study, the following recommendations are hereby suggested:

1. There is no doubt that the smaller the student-teacher ratio, the better the educational quality of both high and low intelligent schools. Those in charge of this arrangement should endeavor to scale down the number of students per class by employing more high quality teachers.
2. The teachers and the students should be properly motivated for optimum productivity.
3. Efforts should be made to improve the intellectual ability of the not-so-gifted students by teaching them at their own pace and being patient with them.
4. The practice of separating the low from the high performing students should be discouraged as that creates room for the feelings of inferiority and superiority complexes amongst them which is unhealthy. Mixing them promotes the spirit of healthy competition as the low achievers will feel challenged to struggle harder to meet up with their class mates.
5. Teachers in schools that practice separation should know that the low performers need extra attention from them instead of shying away from entering their classes or paying good attention to help them improve.
6. Counseling services should be given to the low performers from time to time to encourage them not to lose hope but work harder to perform better.

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