Learning Analytics: Issues on the Pupil-Teacher Ratio in Public Primary Schools in Nigeria

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Abstract—Pupil-teacher ratio (PTR) is one of the key measurements of quality education. This article presents the pupil-teacher ratio for 133 public primary schools in a local government area (LGA) of Ogun State, Nigeria. The data were obtained from a complete enumeration of the records of each school. It was discovered that the average PTR obtained from the data analysis is higher than the national average. Using PTR equals 35 as a benchmark of Nigeria, only 25 (19%) schools out of the 133 schools considered have an acceptable PTR (below 35), 52 (39%) schools have a moderate PTR (between 35 and 50) and 56 (42%) schools have unacceptable and high PTR (above 50). This article shows that there is high pupil-teacher ratio in the country's public primary schools. This research will be helpful in the following; educational evaluation and assessment, audit and quality assurance, decision makers in the Ministry of Education in gap analysis for recruitment purposes, assessing the level of implementation of policies on education and monitoring of the progress made in attaining development sustainable goals (SDG) as it relates to access to quality education.

Keywords—Education, Learning analytics, Pupil-teacher ratio, Smart campus, Statistics, Teacher, Nigeria

1 Introduction

The pupil-teacher ratio is the total number of pupils in a particular school divided by the total number of qualified teachers. The format for computation of PTR used in this article is the same used by the UNESCO [1]. PTR is often confused with "class size" even though; they are different but similar metrics in educational evaluation. PTR is a key indicator in measuring quality and equity in public primary education. Other indicators as listed by [2] include, but not limited to: educational qualification of the teacher, health condition and intellectual quotient of the pupil, psychological variables such as externalizing or internalizing behavior [3], motivation of the teachers [4], the quality of teaching and teaching aids [5], school-home distance, quality of curriculum and educational policies [6-9], social and environmental factors.

Several authors who have presented similar research papers showed that smaller PTR is desirable for effective learning to take place, citing that higher number of pupils in a class reduces the attention given to each pupil by the teacher, which consequently affect the academic performance, especially at practical classes. Historically, education in general has not received the necessary and adequate funding from governments in Nigeria and that have resulted in its falling standard. One of the manifestations is the prevalence of high PTR of which this article portrays. The official PTR in Nigeria, according to **[2]** is 35 which are often higher in urban areas. The high PTR in the urban areas can be attributed to economic migration from the rural to urban areas.

PTR is a widely researched concept in educational evaluation, audit and management. Stakeholders such as parents [10], voters [11], researchers [12], economists [13] believe that low PTR is good for their wards. Privately owned or funded schools seem to have a low PTR [14-15] and often times, policies are formulated and implemented by government to reduce PTR of public primary schools by increasing space allocation [16], building more schools to boost school enrolment [17], subsidy strategies [18], resource expansion and improved budgetary allocations [19-20], progressive pedagogy [21], class-size reduction and staffing. The strategies are necessary to address the issue of fading productivity of schooling [22] and encourage early childhood education [23].

This work presents an analysis of data of the number of teachers and the pupils in government funded primary schools across the LGA considered. Low or high PTR is just one of the concerns of primary education, others can be seen in [24-28].

2 Literature Review

There are diverse views on the impact of PTR on academic performance, human capital development, economy, after school life and so on. Coincidentally, some of the views about the effect of PTR have proven to be insignificant on the educational, sociological and psychological variables. A survey of literature is done to outline the perceived relationship, independence and associations of PTR and some studied variables.

Generally, researchers have found out that PTR and other factors are significant predictors of learning or educational attainment of pupils. These are presented in Table 1. It should be noted that the perceived significant relationship may not account for hidden or unexplained variables that were not pictured in by the various researchers.

In addition, it has been observed that the following have a significant effect on PTR; expansion of charter schools [38], infant mortality [39] and skill-biased technological changes [40].

Table 1. Authors' contributions to the general significance of PTR on some factors or variables

Factors	Authors
Per pupil non-teaching expenditure, PTR, teaching experience and instructional hours.	[29]
Age, socioeconomic background and PTR	[30]
Expenditure per student, PTR, and families' background	[31]
School management, teaching and learning resources, PTR and syllabus coverage	[32]
Sanitation facilities in school, enrolment ratio, environment, drinking water, space-student ratio, PTR and dropout and repetition rates	[33]
Educational expenditure and PTR	[34]
PTR	[35-37]

2.1 Pupil-teacher ratio as a significant positive predictor

PTR has been found to have a positive correlation or a link or association with some educational, sociodemographic, psychological, socioeconomic, pedagogical and environmental variables. A look at previous works in the literature showed that the association is often studied simultaneously with other identified variable or school input. In the developing countries, free education inevitably increases the PTR **[41]** because of increased access and subscription, and high enrolment rate while in the developed countries, free education reduces the PTR because of calculated efforts are done to increase the carrying capacity of schools and recruitment of more qualified teachers.

Five broad areas were identified here, which are:

- Effect of PTR on teachers
- Educational attainment
- Cognitive abilities
- Life after school
- Drop-out

Effect of PTR on teachers: The educational qualification and wages were identified to be positively correlated with PTR [42]. Highly skilled teachers are normally assigned to big classes for the purposes of maximum impact and return on investment. Ordinarily, high wages are paid as compensation. On the other hand, high PTR often leads to high incidence of teachers' sickness absenteeism [43], voice disorders [44] and burn outs [45].

Effect of PTR on educational attainment: PTR has been found to be less significant positively correlated with educational attainment of the pupils [46-47], although, parental education [48], strong pedagogical strategies [49] and ICT adoption [50] have more impact.

Effect of PTR on cognitive ability: PTR has been found to be positively related to the ability of pupils to perform well on cognitive tests. It has been identified to be true in mathematics [51] and language proficiency [52] tests.

Effect of PTR on life after school: PTR has been found to be positively correlated with labor, employment and some aspects of life after school. These come in the form of larger capital to labor ratio [53], higher enumeration and job satisfaction [54], benefit from less intergenerational mobility [55], decreased probability of being unemployed after school [56] and health lifestyle [57].

Effect of PTR on pupil dropout: Pupils are more likely to drop out of school (early school-leaving) if the school they attend is associated with a higher PTR or lower expenditure per pupil [58-59]. These are predominant features in developing countries, where teacher pupil interaction and advising is very minimal because of high PTR.

2.2 Teacher-pupil ratio as significant negative predictor

PTR has been found to have a negative correlation or association with some educational, sociodemographic, psychological, socioeconomic, pedagogical and environmental variables. That is the high PTR leads to a reduction of the effects of the studied variable or school input and vice versa.

Low PTR has been identified to lead to high returns on education [60], which readily reflects on the cognitive performance of the pupils [61]. High level of monetary investments in education measured as expenditure per pupil leads to lower PTR [62-63]. The consequences of such spending are restriction of access [64-65] and engagement of inexperienced teachers and a reduction of teachers' remuneration [66]. On the other hand, a reduction in the educational facilities leads to high PTR [67-68]. This scenario is readily found in the developing countries where government reduces the school fees without investing in the infrastructure that will cater for the increased number of pupils anticipated as a result of the fee reduction. The increased enrollment rate will inevitably snowballed into high PTR. The geographical size is also related to PTR as increasing district sizes reduce the PTR [69-70].

The quality of education has been found to be negatively correlated with PTR [71], as the perceived quality [72] and examination pass rates [73] erode with increasing PTR. Although the trend can be reversed by recruitment of additional teachers [74]. The teachers, on the other hand, often demand for high incentives in order to deliver efficiently [75], which leads to low PTR, increasing pupil-teacher interaction [76] and enhancing job satisfaction [77].

Other areas where PTR has been identified to be negatively correlated with some variables include: foreign direct investments (FDI) [78], district poverty rates [79], manufacturing productivity [80], environmental noise levels [81], gay-straight alliances [82], elevated suicide ideation [83] and crime [84].

2.3 PTR is not a significant predictor

The last case is the instances where the PTR has no significant effect on the studied variable or educational input presented by the various authors. That is, neither no link exists between PTR and the variables and factors, nor does PTR contribute to their significance. Some of such instances of zero correlation are listed.

PTR was found neither to be related to geographical boundaries [85] nor contributes to bullying behaviors [86]. Furthermore, PTR is not associated with matriculation pass rate [87], career choice of pupils after school [88], educational qualifications or remuneration [89-90] and greenness performance [91]. Finally, authors have reported that there seem to be no link between PTR and educational attainment [92-93] or cognitive performance of pupils [94-95].

3 Materials and Methods

The details on how the data was obtained from the study area and the statistical methodology are presented.

3.1 Study area and data

The data were obtained from the records of 133 public primary schools in a local government area (LGA) in Ogun State, Nigeria. The records were collected from the official school and staff registers at the various schools with the condition that the data should be used for academic and scholarly purposes only. Privately funded and special primary schools were not considered. The raw data contains the number of teachers and the pupils in government funded primary schools across the LGA considered.

3.2 Computation of PTR

The PTR can be calculated using the formula;

$$\text{PTR} = \frac{\text{Total Number of Pupils in a school}}{\text{Total Number of Teachers in a school}}$$

3.3 Statistical analysis

Descriptive statistics and ranking were used to present information obtained from the analysis of the data. Similar analysis has been performed on some related educational data [96-100].

4 Results and Discussion

4.1 PTR Computation and descriptive statistics

The pupil-teacher ratio was computed for each of the schools and presented in Table 2. Thereafter, the results of the descriptive statistics of the number of students and the teachers are presented.

Table 2. The number of pupils and teachers and the PTR in the 133 schools

S/N	Teacher	Male pupil	Female pupil	Total pupil	Pupil-Teacher Ratio
1	9	275	257	532	59.11
2	15	280	285	565	37.67
3	11	297	278	575	52.27
4	12	231	201	432	36.00
5	12	325	252	577	48.08
6	8	200	162	362	45.25
7	12	242	272	514	42.83
8	14	265	267	532	38.00
9	17	339	311	650	38.24
10	14	379	325	704	50.29
11	12	322	306	628	52.33
12	13	379	356	735	56.54
13	12	346	278	624	52.00
14	8	228	220	448	56.00
15	13	270	277	547	42.08
16	8	239	208	447	55.88
17	10	200	143	343	34.30
18	15	342	309	651	43.40
19	9	228	201	429	47.67
20	12	324	324	648	54.00
21	6	83	93	176	29.33
22	10	170	179	349	34.90
23	7	223	182	405	57.86
24	5	120	126	246	49.20
25	9	325	318	643	71.44
26	10	256	253	509	50.90
27	13	250	209	459	35.31
28	11	291	278	569	51.73
29	12	285	272	557	46.42
30	12	288	269	557	46.42
31	5	130	99	229	45.80
32	14	64	62	126	9.00
33	3	29	22	51	17.00
34	2	34	37	71	35.50
35	3	68	70	138	46.00
36	12	211	200	411	34.25
37	2	48	47	95	47.50
38	4	83	62	145	36.25
39	8	71	84	155	19.38
40	6	174	189	363	60.50
41	14	283	308	591	42.21
42	3	64	59	123	41.00
43	5	71	71	142	28.40
44	7	149	143	292	41.71
45	6	106	99	205	34.17
46	3	74	86	160	53.33

47	8	147	157	304	38.00
48	7	151	163	314	44.86
49	8	136	153	289	36.13
50	6	83	98	181	30.17
51	8	142	134	276	34.50
52	14	350	350	700	50.00
53	3	68	67	135	45.00
54	7	122	149	271	38.71
55	12	215	206	421	35.08
56	16	254	262	516	32.25
57	9	222	213	435	48.33
58	11	370	316	686	62.36
59	5	157	153	310	62.00
60	12	396	393	789	65.75
61	4	77	62	139	34.75
62	9	342	348	690	76.67
63	7	247	218	465	66.43
64	9	249	218	467	51.89
65	4	67	84	151	37.75
66	5	108	111	219	43.80
67	3	57	63	120	40.00
68	4	126	86	212	53.00
69	4	72	88	160	40.00
70	3	94	70	164	54.67
71	5	215	180	395	79.00
72	6	95	75	170	28.33
73	4	62	38	100	25.00
74	11	323	344	667	60.64
75	5	155	142	297	59.40
76	9	199	187	386	42.89
77	4	133	139	272	68.00
78	6	81	96	177	29.50
79	5	112	124	236	47.20
80	4	170	155	325	81.25
81	6	151	153	304	50.67
82	12	335	271	606	50.50
83	3	110	97	207	69.00
84	8	303	260	563	70.38
85	10	333	293	626	62.60
86	6	83	66	149	24.83
87	6	185	158	343	57.17
88	9	258	224	482	53.56
89	10	266	251	517	51.70
90	10	290	251	541	54.10
91	6	108	94	202	33.67
92	8	228	188	416	52.00
93	9	222	221	443	49.22
94	4	179	153	332	83.00
95	4	129	47	176	44.00

96	5	225	247	472	94.40
97	8	246	250	496	62.00
98	4	112	108	220	55.00
99	4	145	151	296	74.00
100	10	274	212	486	48.60
101	14	352	346	698	49.86
102	6	147	171	318	53.00
103	6	148	139	287	47.83
104	8	150	127	277	34.63
105	4	122	129	251	62.75
106	6	211	157	368	61.33
107	4	98	112	210	52.50
108	5	124	132	256	51.20
109	12	296	273	569	47.42
110	9	381	310	691	76.78
111	7	129	123	252	36.00
112	13	264	278	542	41.69
113	7	196	188	384	54.86
114	8	235	284	519	64.88
115	13	299	293	592	45.54
116	7	156	154	310	44.29
117	13	218	221	439	33.77
118	12	206	187	393	32.75
119	12	226	241	467	38.92
120	12	235	247	482	40.17
121	15	250	207	457	30.47
122	11	292	253	545	49.55
123	13	369	321	690	53.08
124	9	244	245	489	54.33
125	11	160	183	343	31.18
126	13	224	179	403	31.00
127	9	193	203	396	44.00
128	11	218	262	480	43.64
129	14	294	259	553	39.50
130	12	203	214	417	34.75
131	8	222	185	407	50.88
132	8	190	176	366	45.75

The distribution of the population of teachers, male and female students are shown in Figures 1, 2 and 3.

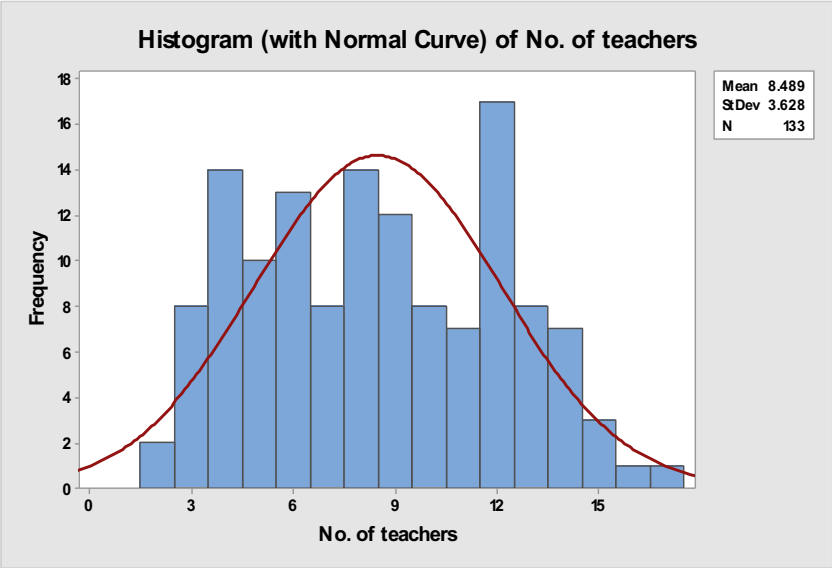

Fig. 1. Histogram showing the distribution of teachers across the LGA

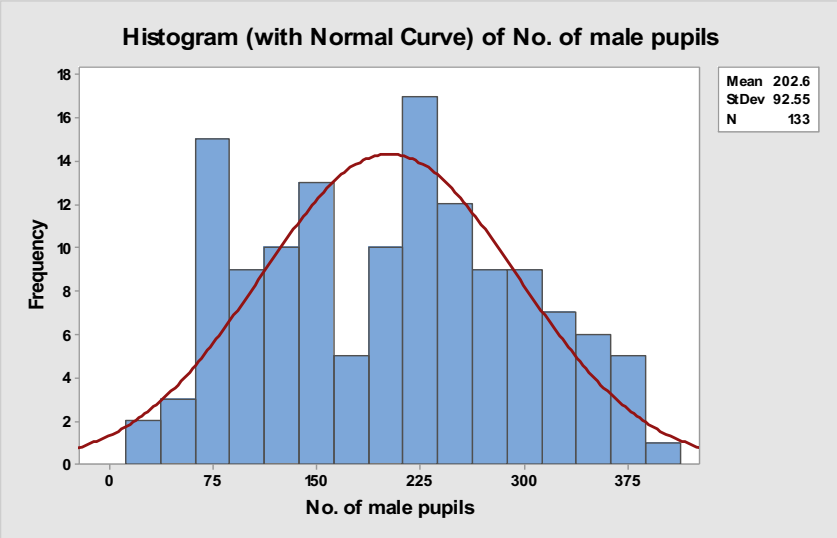

Fig. 2. Histogram showing the distribution of male pupils across the LGA

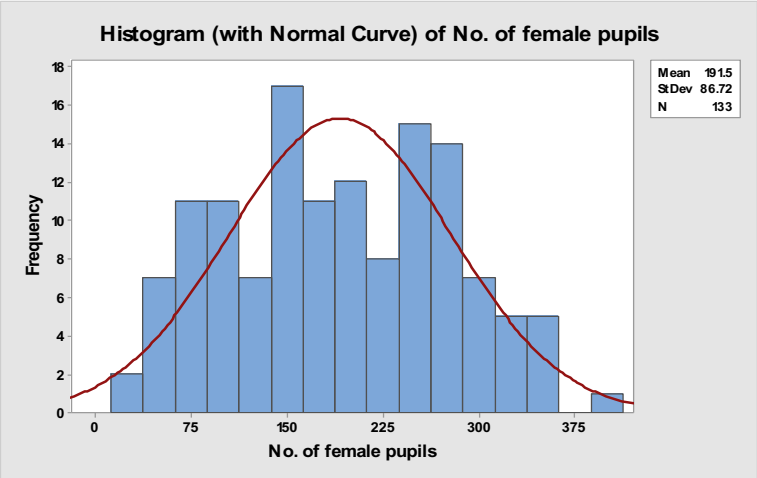

Fig. 3. Histogram showing the distribution of female pupils across the LGA

The descriptive statistics on the variables; teacher, number of male pupils and number of female pupils is presented in Table 3.

Table 3. Descriptive Statistics: No. of teachers, No. of male pupils, No. of female pupils

Variable	Mean	Sum	Median	Skewness	Kurtosis
No. of teachers	8.489	1129.000	8.000	0.14	-1.01
No. of male pupils	202.64	26951.00	211.00	0.09	-0.95
No. of female pupils	191.50	25469.00	188.00	0.05	-0.92

Remark: The schools across the LGA considered recorded more male pupils (26951) than female pupils (25469).

4.2 PTR Ranking

It is clear to all the PTR is not the same for all the schools considered as seen in Table 2. It is then necessary to know the schools with high PTR (PTR of more than say 35). The ranks of the schools considered based on their pupil-teacher ratio is presented in Table 4. The PTR was arranged from the highest to the lowest values. The ranking yielded three non-overlapping groups which are distinctly colored.

Table 4. The rank of the 133 schools based on the values of their PTR

S/n	Teacher	Total	Pupil-teacher ratio
96	5	472	94.40
94	4	332	83.00
80	4	325	81.25
71	5	395	79.00
110	9	691	76.78
62	9	690	76.67
99	4	296	74.00

25	9	643	71.44
84	8	563	70.38
83	3	207	69.00
77	4	272	68.00
63	7	465	66.43
60	12	789	65.75
114	8	519	64.88
105	4	251	62.75
85	10	626	62.60
58	11	686	62.36
59	5	310	62.00
97	8	496	62.00
106	6	368	61.33
74	11	667	60.64
40	6	363	60.50
75	5	297	59.40
1	9	532	59.11
23	7	405	57.86
87	6	343	57.17
12	13	735	56.54
14	8	448	56.00
16	8	447	55.88
98	4	220	55.00
113	7	384	54.86
70	3	164	54.67
124	9	489	54.33
133	10	543	54.30
90	10	541	54.10
20	12	648	54.00
88	9	482	53.56
46	3	160	53.33
123	13	690	53.08
68	4	212	53.00
102	6	318	53.00
107	4	210	52.50
11	12	628	52.33
3	11	575	52.27
13	12	624	52.00
92	8	416	52.00
64	9	467	51.89
28	11	569	51.73
89	10	517	51.70
108	5	256	51.20
26	10	509	50.90
131	8	407	50.88
81	6	304	50.67
82	12	606	50.50
10	14	704	50.29
52	14	700	50.00

101	14	698	49.86
122	11	545	49.55
93	9	443	49.22
24	5	246	49.20
100	10	486	48.60
57	9	435	48.33
5	12	577	48.08
103	6	287	47.83
19	9	429	47.67
37	2	95	47.50
109	12	569	47.42
79	5	236	47.20
29	12	557	46.42
30	12	557	46.42
35	3	138	46.00
31	5	229	45.80
132	8	366	45.75
115	13	592	45.54
6	8	362	45.25
53	3	135	45.00
48	7	314	44.86
116	7	310	44.29
95	4	176	44.00
127	9	396	44.00
66	5	219	43.80
128	11	480	43.64
18	15	651	43.40
76	9	386	42.89
7	12	514	42.83
41	14	591	42.21
15	13	547	42.08
44	7	292	41.71
112	13	542	41.69
42	3	123	41.00
120	12	482	40.17
67	3	120	40.00
69	4	160	40.00
129	14	553	39.50
119	12	467	38.92
54	7	271	38.71
9	17	650	38.24
8	14	532	38.00
47	8	304	38.00
65	4	151	37.75
2	15	565	37.67
38	4	145	36.25
49	8	289	36.13
4	12	432	36.00
111	7	252	36.00

34	2	71	35.50
27	13	459	35.31
55	12	421	35.08
22	10	349	34.90
61	4	139	34.75
130	12	417	34.75
104	8	277	34.63
51	8	276	34.50
17	10	343	34.30
36	12	411	34.25
45	6	205	34.17
117	13	439	33.77
91	6	202	33.67
118	12	393	32.75
56	16	516	32.25
125	11	343	31.18
126	13	403	31.00
121	15	457	30.47
50	6	181	30.17
78	6	177	29.50
21	6	176	29.33
43	5	142	28.40
72	6	170	28.33
73	4	100	25.00
86	6	149	24.83
39	8	155	19.38
33	3	51	17.00
32	14	126	9.00

The current PTR in Nigeria is 35, that is, 35 pupils to a teacher. 56 schools with red color have high PTR and requires more teachers to reduce the value of the PTR, which is PTR of 50 and above. However, those with yellow color are adjudged to be acceptable (25 schools), which is PTR of 35 and below. The acceptability is subject to interpretation from the Nigerian context, because the survey area is one of the educational developed states in Nigeria and, ordinarily, it is expected that the PTR should be small. However, this article points to the contrary. Moreover, it is expected that PTR should be high in education less developed states of the country which are the northern and the Niger Delta area of the country.

5 Conclusion

The research had led to the following conclusions:

- Only 25 (19%) schools out of the 133 schools considered have an acceptable PTR (below 35).
- 52 (39%) schools out of the 133 schools considered have a moderate PTR (between 35 and 50).

- 56 (42%) schools out of the 133 schools considered have unacceptable and high PTR (above 50).
- More qualified teachers are urgently needed in these schools in order to ensure effective teaching and learning are taking place
- Adequate funding should be provided by the government to sustain these schools and to ensure that these pupils are not deprived of their basic rights.

This research will be helpful in educational evaluation and assessment, audit and quality assurance, to decision makers in the Ministry of Education in gap analysis for recruitment purposes, assessing the level of implementation of policies on education and to monitor the progress made in attaining development sustainable goals (SDG) as it relates to access to quality education.

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