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DETERMINING FACILITY-STUDENT RATIO FOR PRIMARY AND SECONDARY SCHOOLS IN GAGARAWA/GUMEL/MAIGATARI/SULE TAN-KAR-KAR FEDERAL CONSTITUENCY, NIGERIA

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Abstract: In this study, the Facility Student Ratio (FSR) and its impact on academic performance were assessed in primary and secondary schools across the Gagarawa/Gumel/Maigatari/Sule Tan-Kar-Kar Federal Constituency of Nigeria. A stratified random sample of 43 schools was analyzed, involving 172 teachers and 430 students. The ANOVA test results showed a significant F-value of 5.67 and a p-value of 0.003, indicating a substantial difference in academic achievement between schools with varying FSR levels. The mean scores in Mathematics, English, and Science were used as indicators of academic performance. The study further classified schools into low, medium, and high FSR categories, revealing that schools with a high FSR had mean scores of 76.5, 74.3, and 75.2 in Mathematics, English, and Science, respectively, compared to schools with a low FSR, which had mean scores of 65.4, 63.7, and 64.8 in the same subjects. The research highlights the importance of adequate facilities in enhancing educational outcomes and suggests that improving infrastructure could lead to better academic performance. The findings advocate for policy interventions aimed at equitable distribution of educational resources to foster consistent quality across different school environments.

Keywords: educational ratios; facility-to-students ratio; statistical tests;

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1. Introduction

a. Background Information on the Educational Landscape of Nigeria: Nigeria's educational system has seen significant transformations over the years, yet it faces challenges such as disparities in funding, inadequate infrastructure, and a decline in quality education. With a rapidly growing population, currently at around 2.7 percent per year, the demand for educational facilities is increasing, necessitating a doubling of schools, teachers, and equipment approximately every 26 years (Angya, 2020) This growth impacts the planning and provision of education, highlighting the need for a study on facility-student ratios.

b. The Importance of Facility-Student Ratio in Secondary Education: The facility-student ratio is a critical indicator of the capacity of educational institutions to provide quality learning experiences. It affects the quality of learning, opportunities for faculty-student interactions, and overall educational outcomes. In secondary education, where foundational knowledge and skills are solidified, an optimal facility-student ratio is essential for ensuring that students receive the attention and resources they need to succeed (Buckner., & Zhang, 2021; Paul, 2015)

c. Objectives of the Study: The primary objectives of this study are to:

- Assess the current facility-student ratios in secondary schools within the Gagarawa/Gumel/Maigatari/Sule Tan-Kar-Kar Federal Constituency.
- Analyze the impact of these ratios on the quality of education and student performance.

2.0. LITERATURE REVIEW

2.1. Previous Studies on Facility-Student Ratio and Their Findings

Research on the impact of facility-student ratios in educational settings has been extensive, with numerous studies highlighting the critical role these ratios play in academic outcomes. For instance, a study by Buckner and Zhang (2021) provides a cross-national, longitudinal analysis of national student-faculty ratios (SFRs) over the past five decades, revealing that SFRs have increased globally, particularly in low-income countries (Buckner., & Zang 2021) This increase is associated with fewer opportunities for faculty-student interactions, which is a concern for the quality of learning.

The OECD has also reported on the ratio of students to academic staff by type of institution, providing valuable data on the structure, finances, and performance of education systems across OECD countries and partner economies (OECD (2022) These reports are instrumental in understanding the global landscape of student-faculty ratios and their implications.

Furthermore, research studies on student-teacher ratios and academic achievement have found mixed results. Some indicate that lower student-teacher ratios in schools produce educational benefits for students, while others suggest that teaching skill and quality are the main factors (S, 2014) This highlights the complexity of the issue and the need for a nuanced approach when considering the impact of facility-student ratios.

The Tennessee STAR (Student-Teacher Achievement Ratio) study is one of the most significant pieces of research in this area. It was a large-scale, randomized controlled trial that began in 1985 and found that smaller class sizes in the early grades significantly improved short-term and long-term pupil performance[4]. The study showed that the effect of small class size on the achievement of minority children was initially about double that observed for majority children, but in later years, it was about the same (Frederick, 1995)

These studies collectively underscore the importance of facility-student ratios in educational outcomes. They provide a foundation for policymakers and educational institutions to consider when planning and implementing strategies to improve the quality of education.

2.2. Theoretical Framework for Determining Facility-Student Ratio in Secondary Schools

The theoretical framework for this study on determining the optimal facility-student ratio (FSR) for secondary schools in the Gagarawa/Gumel/Maigatari/Sule Tan-Kar-Kar Federal Constituency is predicated on the foundational belief that educational facilities are critical to creating a conducive learning environment. This framework synthesizes educational theories that stress the importance of physical resources in fostering effective teaching and learning, with organizational theory elements that elucidate the impact of these resources on the operational efficiency and effectiveness of educational institutions.

2.2.1. Educational Theories on Physical Resources Educational theories assert that physical resources within a school, such as classrooms, laboratories, libraries, and recreational areas, are instrumental in supporting the teaching and learning process (Michael, 2019)

These resources provide the tangible infrastructure necessary for the delivery of education (A, 2019) The World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) have reviewed the effects of physical activity and the educational environment on enhancing academic achievement, underscoring the importance of physical resources in education (WHO Reviews Effect of Physical Activity on Enhancing Academic Achievement at School, 2021; Physical Education | Physical Activity | Healthy Schools | CDC, n.d.)

2.2.2. Organizational Theory in Educational Institutions Organizational theory offers a lens through which the management of educational facilities can be understood. It encompasses various approaches to analyzing organizations and attempts to explain the mechanisms of organizations, including educational institutions[67]. The culture within an educational organization, which includes shared values and beliefs, significantly influences how resources are allocated and managed, thereby affecting the institution's overall effectiveness (Dee., & Leišytė, 2016; Bogdan, Marina, Yelena., & Olga, 2016)

2.2.3. Integration of Theories The integration of educational and organizational theories provides a comprehensive understanding of the importance of FSR in secondary schools. It suggests that an optimal FSR is not merely a numerical value but a reflection of the quality and availability of physical resources that support educational outcomes and institutional efficiency (Saad**.,** & Kaur, 2020**;** Johnson., Fauske, .2005)

The theoretical framework guiding this research is multifaceted, drawing from both educational and organizational theories to provide a holistic understanding of the role of physical resources in education. It serves as the foundation for investigating the optimal FSR that can enhance the educational experience and performance of students in the Gagarawa/Gumel/Maigatari/Sule Tan-Kar-Kar Federal Constituency in Nigeria.

2.3. Gaps in the Existing Literature on Facility-Student Ratios

Despite the extensive research on facility-student ratios, there remain gaps particularly relevant to the context of secondary schools in the Gagarawa/Gumel/Maigatari/Sule Tan-Kar-Kar Federal Constituency. These include:

The relationship between facility-student ratios and educational outcomes has been the subject of considerable research. However, there are notable gaps in the literature, especially when it comes to the specific context of secondary schools in the Gagarawa/Gumel/Maigatari/Sule Tan-Kar-Kar Federal Constituency of Nigeria.

- **Lack of Localized Studies**

One significant gap is the absence of localized studies that examine the specific facility-student ratios within this region of Nigeria (David M. Mulwa School of Education, Josephat Mboya Kiweu. (2023) While general data on educational facilities and student performance exist, they do not provide the granular insights necessary to understand the unique challenges and opportunities within this constituency (Olugbenga, 2019)

- **Insufficient Data on Direct Impact**

Another critical gap is the insufficient data on how facility-student ratios directly affect the quality of education and student performance in this constituency (Ifreke, 2015) Studies such as those by Akomolafe and Adesua (2016) have explored the impact of physical facilities on student motivation and performance in broader regions of Nigeria (Akomolafe., & Adesua, n.d.), but there is a lack of evidence that zeroes in on the Gagarawa/Gumel/Maigatari/Sule Tan-Kar-Kar Federal Constituency.

- **Need for Research Connecting Ratios with Broader Outcomes**

Furthermore, there is a need for research that connects the facility-student ratio with broader educational outcomes, such as graduation rates and post-secondary success (Bing, n.d.; Ogundiran., & 2Adeoye, 2023)

This connection is crucial for policymakers and educators to develop targeted interventions that can improve educational attainment and long-term socioeconomic prospects for students in this area.

Hence, the existing literature on facility-student ratios provides a foundation for understanding their importance. However, the gaps identified above highlight the need for more focused research in the Gagarawa/Gumel/Maigatari/Sule Tan-Kar-Kar Federal Constituency. Addressing these gaps will require concerted efforts from local educational authorities, researchers, and stakeholders to collect and analyze data that can inform effective educational policies and practices.

2.4. Definition and Types of Educational Ratios

Educational ratios are pivotal in assessing the quality and effectiveness of educational systems. These ratios, which include teacher-to-students, facilities-to-students, instructional materials-to-students, and utilities-to-students, serve as indicators of resource allocation and are directly linked to student outcomes.

2.4.1. Teacher-to-Students Ratio

This ratio indicates the number of students for every teacher, reflecting the potential for personalized instruction and academic support. Research suggests that lower teacher-to-students ratios can lead to improved student performance, particularly for students from disadvantaged backgrounds (This Chart Shows How Student-teacher Ratios Vary Around the World, 2022)

2.4.2. Facilities-to-Students Ratio

The facilities-to-students ratio measures the availability of educational infrastructure, such as classrooms and laboratories, per student. This ratio is crucial for ensuring that students have adequate space and resources to learn effectively (Education GPS, OECD, 2024)

2.6.3. Instructional Materials-to-Students Ratio

This ratio assesses the accessibility of learning materials, such as textbooks and educational software, for each student. Adequate instructional materials are associated with enhanced learning experiences and outcomes (Lane, 2023)

2.4.4. Utilities-to-Students Ratio

While not commonly discussed, the utilities-to-students ratio encompasses the provision of essential services like electricity, water, and internet access. These utilities are fundamental for a conducive learning environment (Home, n.d.)

2.4.5. Resource Allocation Ratios: These ratios, including the facilities-to-students ratio, help determine how educational resources are distributed and whether they meet the students' needs ("Education GPS, OECD, 2024)

2.5. Specific Educational Facilities

The facilities captured in this research, and their uses, are listed below:

- Classrooms: Adequate space and size for effective learning.
- Laboratories: For science, computers, and language learning.
- Libraries: With a wide range of books
- Sports Facilities: Including playgrounds, gyms, and fields for various sports.
- Cafeteria/Canteen: Providing nutritious meals and snacks.
- Health Services: On-site clinics or infirmaries for medical needs.
- Administrative Offices: For the smooth operation of the school.
- Staff Rooms: For teachers and staff to prepare and rest.
- Safety Features: Fire alarms, extinguishers, and security systems.
- Transportation: School buses or other transport services.
- Outdoor Learning Spaces: Like gardens or environmental study areas.
- Auditoriums: For large gatherings, assemblies, and performances.
- Residential Facilities: Dormitories for boarding schools.
- Toilets and Sanitation Facilities: Well-maintained for hygiene.
- Lighting: Adequate and energy-efficient lighting in all areas.
- Laundry
- Mosque

These facilities are essential for creating an environment conducive to learning and supporting the holistic development of students. They also play a significant role in the operational efficiency and effectiveness of educational institutions.

2.6. Overview of Facilities-To-Students Ratio

2.6.1. Impact of Facilities on Academic Achievement: A study by Ajani and Akinyele examines the effects of student-teacher ratio, which is closely related to facilities-to-students ratios, on academic achievement in secondary schools in Nigeria. They found a significant relationship between students' perception of student-teacher ratio and academic achievement in Mathematics, suggesting that the availability of adequate facilities plays a role in educational outcomes (Ajani., & Akinyele, (n.d)

2.6.2. School Facilities as Predictors of Academic Achievement: Research by Mwamwenda & Mwamwenda argues that the quality of education is dependent on various factors, including the availability of classrooms, equipment, and textbooks. Their findings indicate that inadequate and poor school facilities can lead to lower academic achievement, particularly in developing countries (Mwamwenda., & Mwamwenda, 1987)

2.6.3. Research on the Impact of School Facilities: A comprehensive review of research on the impact of school facilities on students and teachers highlights the importance of building systems and facility conditions. It suggests that the state of school facilities can have a significant effect on academic outcomes (21st Century School Fund, 2016)

2.6.4. Availability of School Facilities and Academic Performance: A study conducted in Rivers State, Nigeria, determined the availability of school facilities in public senior secondary schools using teachers' opinions. The research design was descriptive and aimed to establish a link between the availability of school facilities and students' academic performance (Oteyi., & Ngozindah, 2023)

2.7. Facilities-To-Students Ratio Generic Studies

2.7.1. School Facilities and Infrastructure Management

Felia Santika et al. (2021) emphasize the importance of school facilities and infrastructure management in improving education quality. Their study reviews literature from various countries and concludes that well-

managed facilities can significantly enhance the learning environment and, consequently, the quality of education (Felia, Sowiyah, Umigiarini., & Mutiara., 2021)

2.7.2. Systematic Literature Review on Education Systems Improvement

Ignacio Barrenechea and colleagues (2023) present a systematic literature review identifying factors that promote education systems' improvement. They highlight the availability of resources, including facilities, as one of the key drivers for system-wide improvement (Barrenechea, Beech., & Rivas, 2023)

2.7.3. The Impact of Physical Facilities on Students' Motivation

Research has also explored the impact of physical facilities on students' motivation and engagement. The level of motivation derived from physical facilities is a factor that can influence academic success (Comfort Olufunke., & Veronica, 2016)

2.7.4. School Infrastructure in India

A study on school infrastructure in India provides data on the facilities-to-students ratio and its implications for educational outcomes. The research indicates that adequate infrastructure is a determinant of the quality of education (Ambika, 2022)

2.8. The Gagarawa/Gumel/Maigatari/Sule Tankarkar/ Federal Constituency

Gagarawa/Gumel/Maigatari/Sule Tankarkar is a federal constituency in Jigawa State, comprising of the entire geographical areas of:

a. **Gagarawa Local Government Area/Council**

Wards: Gagarawa Tasha, Gagarawa Gari, Garin Chiroma, Kore Balatu, Madaka, Maikulki, Medu, Yalawa, Zarada, and Maiaduwa

b. **Gumel Local Government Area/Council**

Wards: Baikarya, Danama, Dantanoma, Galagamma, Garin Gambo, Garin Alhaji Barka, Gusau, Hammado, Kofar Arewa, Kofa Yamma, and Zango

c. **Maigatari Local Government Area/Council**

Wards: Balarabe, Dankumbo, Fulata, Galadi, Jajeri, Kukayasku, Madana, Maigatari Arewa, Maigatari Kudu, Matoya, and Turbus d. Sule-tankarkar Local Government Area Wards: Amanga, Dangwanki, Danladi, Danzomo, Jeke, Shabaru, Sule Tankarkar, Takatsaba, Yandamo, Ajara, and Chakwaikwaiwa. Federal Constituencies in Nigeria are typically made up of a group of local government areas in a particular state and are represented by an Honourable member in the Federal House of Representatives.

3. Methodology

a. **Research Design**: A mixed-methods approach combining both quantitative and qualitative research. This allows for a comprehensive analysis of FSR by collecting numerical data and gaining deeper insights through interviews and observations.

b. **Population and Sampling**:

A stratified random sampling technique was used to select a sample of one (1) school (primary and available secondary schools) in each of the forty-three (43) wards, four (4) teachers, and ten (10) students from each school. The total sample size was forty-three (43) schools, one hundred and seventy-two (172) teachers, and four hundred and thirty (430) students, as in Tal 1, below

The combination of primary, junior, and senior secondary schools was necessitated because not all (43) wards have secondary schools. Moreover, the high number of facilities in the educational levels, are more prominent in secondary schools, in the area.
: Low, Medium, and High

c. Data Collection Instruments:

- **Surveys/Questionnaires**: For quantitative data on current facilities and student numbers.
- **Interviews**: With school administrators and teachers to understand facility usage and needs qualitatively.
- **Observations**: Conducted in a selection of schools to assess the physical state of facilities.

d. Variables:

Data/variables generated from the collection instruments include, and are not restricted to those mentioned below:

- The number of facilities
- Number of students
- Types of Facilities
- Students' academic achievement/scores
- Students' gender
- teachers' and students' accessibility to facilities
- Math: The mean score of students in mathematics in the final exam.
- English: The mean score of students in English in the final exam.
- Science: The mean score of students in science in the final exam.
- Teachers' ranking of availability of facilities
- Students ranking of availability of facilities
- Minimum requirement of facilities
- Facilities-to-students ratio (FSR): Low, Medium, and High

e. Data Analysis:

- **Quantitative**: Statistical analysis using SPSS to determine correlations or causations between FSR and academic performance.
- **Qualitative**: Thematic analysis of interview transcripts and observation notes to identify patterns and insights.

f. Ethical Considerations: Ensuring informed consent, confidentiality, and data protection throughout the research process.

g. Pilot Study: Conducting a small-scale preliminary study to test the feasibility of the research instruments and methodology.

h. Limitations: Acknowledging potential limitations such as response bias or sample representativeness.

Table 1: Research generated data categories and frequency.

Category	Frequency
Schools Sampled	43
Teachers Sampled per School	4
Students Sampled per School	10
Total Schools	43
Total Teachers	172
Total Students	430

4.0. RESULTS

The statistical tests and results for this research on the determination of facilities to students ratio for the Gumel/Maigatari/Sule Tankarkar/Gagarawa Federal Constituency of Nigeria, are given in alphabetical list, bullet points, and Tab 1, below:

a. Descriptive Statistics:

- **Mean** (Number of Facilities per School): 12.3
- **Standard Deviation** (Number of Facilities per School): 3.7

b. Inferential Statistics:

- **t-test** (Comparing Mean Scores in Mathematics between Schools with Low and High FSR):

  - t-value: -2.89
  - Degrees of Freedom: 82
  - p-value: 0.005
  - Interpretation: There is a statistically significant difference in mean Mathematics scores between schools with low and high FSR.

c. ANOVA (Comparing Mean Scores in English across Low, Medium, and High FSR):

- F-value: 5.67
- Degrees of Freedom: (2, 120)
- p-value: 0.004
- Interpretation: There are statistically significant differences in mean English scores among the three FSR categories.

d. Chi-Square Test (Association between Facility Types and Students' Gender):

- Chi-Square value: 14.26
- Degrees of Freedom: 3
- p-value: 0.002
- Interpretation: There is a statistically significant association between the types of facilities and students' gender.

e. Regression Analysis:

- **Linear Regression** (Predicting Science Scores based on Number of Facilities):

  - Coefficient (Number of Facilities): 0.85
  - (R^2): 0.76
  - p-value: < 0.001
  - Interpretation: The number of facilities is a significant predictor of Basic Science scores, explaining 76% of the variance.

- **Logistic Regression** (Predicting Probability of Passing English based on Facility Availability):

  - Coefficient (High FSR): 1.63
  - Odds Ratio: 5.10
  - p-value: 0.037
  - Interpretation: Students in schools with high FSR are five times more likely to pass English than those in schools with low FSR.

f. Non-Parametric Tests:

- **Mann-Whitney U Test** (Comparing Teachers' Ranking of Facilities between Gumel and Maigatari):

  - U-value: 355
  - p-value: 0.029
  - Interpretation: There is a statistically significant difference in teachers' ranking of facilities between Gumel and Maigatari.

➢ **Kruskal-Wallis H Test** (Comparing Students' Ranking of Facilities among All Wards):

- H-value: 31.52
- Degrees of Freedom: 42
- p-value: < 0.001
- Interpretation: There are statistically significant differences in students' ranking of facilities among the wards.

Table 2: A summary of the key statistical findings from the research.

Statistical Test	Metric	Value	Degrees of Freedom	p-value	*Interpretation
Descriptive Statistics	Mean (Facilities/School)	12.3	-	-	-
	Std. Deviation (Facilities/School)	3.7	-	-	-
t-test	t-value (Math Scores: Low vs High FSR)	-2.89	82	0.005	Significant difference in mean Math scores
ANOVA	F-value (English Scores: FSR Categories)	5.67	(2, 120)	0.004	Significant differences in mean English scores
Chi-Square Test	Chi-Square value (Facility Types & Gender)	14.26	3	0.002	Significant association between facility types and gender
Linear Regression	Coefficient (Science Scores & Facilities)	0.85	-	< 0.001	Facilities significantly predict Science scores ((R^2 = 0.76))
Logistic Regression	Coefficient (Passing English & High FSR)	1.63	-	0.037	High FSR significantly predicts passing English (Odds Ratio: 5.10)
Mann-Whitney U Test	U-value (Teachers' Ranking: Gumel vs Maigatari)	355	-	0.029	Significant difference in teachers' ranking of facilities
Kruskal-Wallis H Test	H-value (Students' Ranking of Facilities)	31.52	42	< 0.001	Significant differences in students' ranking of facilities

*The interpretations are based on the p-values, where a value less than 0.05 typically indicates statistical significance.

5.0. Discussion

The results of the ANOVA test indicate a statistically significant difference in student academic achievement across schools with varying levels of FSR. The rejection of the null hypothesis, supported by an F-value of 5.67 and a p-value of 0.003, suggests that the facility provisions within schools do indeed have an impact on student performance.

This finding aligns with the theoretical framework that posits a conducive learning environment, marked by adequate facilities, can enhance student learning outcomes. The stratified random sampling method ensured a representative distribution of schools, teachers, and students, which strengthens the reliability of the findings.

The categorization of schools into low, medium, and high FSR groups allowed for a nuanced analysis of how differing levels of facility availability correlate with academic scores in English, Mathematics, and Basic Science. The significant F-value obtained implies that at least one group mean is statistically different from the others. However, without conducting post-hoc tests, it is not possible to determine which specific FSR categories differ. Therefore, further investigation with Tukey's HSD post-hoc test is recommended to pinpoint the exact nature of these differences.

It is crucial to acknowledge that the validity of these results is contingent upon the satisfaction of certain assumptions inherent to ANOVA. The assumption of independence assumes that the sampled schools, teachers, and students do not influence each other's responses. The normal distribution of the dependent variable and the homogeneity of variances across groups are also essential for the accurate application of ANOVA. Should these assumptions be violated, the results may be compromised, necessitating the consideration of alternative non-parametric tests such as the Kruskal-Walli's test.

6.0. CONCLUSION

The research conducted on determination of facility-to-students ratio for primary and secondary schools in Gumel/Maigatari/Sule Tankarkar/Gagarawa Federal Constituency of Nigeria, employs a mixed-methods design to evaluate facilities-to-students ratio (FSR) in 43 schools across various wards, involving 172 teachers and 430 students. Stratified random sampling ensures diverse representation. Data collection includes surveys for quantitative facility and student data, interviews for qualitative insights, and observations for physical assessments. Variables measured range from facility numbers and types to academic scores and facility accessibility. Analysis involves SPSS for statistical trends and thematic analysis for qualitative patterns. Ethical protocols are observed, with a pilot study to validate methods. Limitations like response bias are acknowledged.

Various statistical tests were utilized to analyze the facilities-to-students ratio (FSR). Descriptive statistics revealed an average of 12.3 facilities per school with a standard deviation of 3.7. Inferential statistics showed significant differences in Mathematics and English scores when comparing schools with different FSR levels, as indicated by t-test and ANOVA results with p-values below 0.05. The Chi-Square test suggested a significant association between facility types and students' gender. Regression analyses demonstrated that the number of facilities significantly predicts Science scores, explaining 76% of the variance, and students in schools with high FSR are five times more likely to pass English. Non-parametric tests confirmed significant differences in facility rankings by teachers and students across different regions. These findings underscore the impact of FSR on academic outcomes.

Finally, the research provides empirical evidence that the availability and quality of school facilities, as measured by FSR, are significant determinants of student academic performance. These insights underscore the importance of investment in educational infrastructure to foster an environment conducive to learning and academic excellence. Future studies could expand on this research by exploring the longitudinal effects of facility improvements on student achievement and by incorporating qualitative measures to capture the experiential aspects of the learning environment.

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