JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

DETERMINING FACILITY-TO-STUDENTS RATIO FOR SCHOOLS IN BIRNIN-KUDU/BUJI FEDERAL CONSTITUENCY OF NIGERIA

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Abstract: The research is one (1) out of eleven (11) with similar purpose, across the eleven (11) Federal Constituencies in Jigawa State. It is a mixed-methods research that assessed the facilities-to-students ratio (FSR) for schools in the Birnin-Kudu/Buji Federal Constituency of Jigawa State, Nigeria. A stratified random sample of 21 schools, 126 teachers, and 210 students was analyzed through surveys, interviews, and observations. Descriptive statistics showed an average of 16 facilities per school, with a standard deviation of 4.5. The Chi-Square test (χ^2=12.34, p=0.002) indicated a significant association between facility types and FSR categories. T-test results (t=3.21, p=0.0015) revealed differences in Math scores between low and high FSR schools. ANOVA (F=6.54, p=0.0012) showed disparities in English scores across FSR levels. MANOVA (Pillai's Trace=0.28, p=0.0001) confirmed a multivariate effect of FSR on Math, English, and Basic Science scores. Correlation analysis (r=0.48, p<0.0001) and regression analysis (R^2=0.36, p<0.0001) demonstrated a positive relationship between facilities and Math scores and the explanatory power of FSR on Science scores. Factor analysis identified three factors explaining 65% of the variance, representing academic performance, facility quality, and student access. The Kruskal-Wallis H Test (H=14.76, p=0.00065) highlighted differences in teacher perceptions of facility availability. The study emphasizes the critical role of FSR in academic achievement, advocating for equitable facility distribution to enhance educational outcomes.

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

This research was sponsored by The Tertiary Education Trust Fund (TETFUND)of The Federal Republic Of Nigeria

1. INTRODUCTION

a. Background Information on the Educational Landscape of Nigeria: The Nigerian education sector has undergone considerable changes and continues to evolve. Despite progress, it grapples with issues like unequal funding distribution, subpar infrastructure, and diminishing standards of education. Nigeria's burgeoning population growth rate, which stands at about 2.7% annually, is placing an ever-increasing demand on educational resources. This necessitates the doubling of educational facilities, teaching staff, and materials roughly every 26 years, profoundly affecting educational planning and underscoring the urgency for research into facility-student ratios[1].

b. The Importance of Facility-Student Ratio in Secondary Education: The ratio of facilities to students is a pivotal measure of an educational institution's ability to furnish high-quality learning environments. It influences the caliber of education, the potential for meaningful interactions between faculty and students, and the overall outcomes of the educational process. Given that secondary education is a phase where critical knowledge and skills are entrenched, maintaining an ideal facility-student ratio is vital to ensure that students have access to the necessary attention and resources for their academic success (Home, n.d.)

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 & Zhang, 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. 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.

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

The theoretical underpinning of this research, aimed at identifying the ideal facility-student ratio for secondary schools within the Birnin-Kudu/Buji Federal Constituency, is based on the premise that educational facilities play a pivotal role in fostering an environment conducive to learning. This framework integrates insights from educational theories emphasizing the significance of physical resources in promoting effective instruction and learning, with aspects of organizational theory that clarify the influence of these resources on the operational efficiency and effectiveness of educational institutions.

2.2.1. Educational Theories on Physical Resources

Educational theories highlight that, physical resources, such as classrooms, laboratories, libraries, and recreational areas, are vital in supporting the educational process. These resources constitute the essential infrastructure required for imparting education. Studies have shown that physical activity and a supportive educational environment contribute to improved academic performance, thereby reinforcing the value of physical resources in educational settings (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. The Organizational Theory in Educational Institutions

Organizational theory provides a framework for understanding the administration of educational facilities. It includes diverse methods for examining organizations and seeks to describe how they function, specifically within the context of educational entities. The prevailing culture in an educational organization, encompassing common values and beliefs, greatly impacts the allocation and management of resources, thus influencing the overall efficacy of the institution (Peter, Alberto, Tigran, Diego., & Maria, 2019)

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

While there has been extensive investigation into the facility-student ratios and their effects on educational outcomes, specific gaps remain, particularly in the context of secondary schools in the Birnin-Kudu/Buji Federal Constituency. These gaps include:

2.3.1. Lack of Localized Studies There is a notable absence of localized research focusing on the distinct facility-student ratios within this Nigerian region (Peter, Alberto, Tigran, Diego, and Maria Ustinova, 2019) Although there is general information available on educational facilities and student performance, it lacks the detailed insights needed to fully comprehend the unique challenges and opportunities present in this constituency (Amina., & Iddrisu, 2017)

2.3.2. Insufficient Data on Direct Impact Data is lacking on how facility-student ratios directly influence the quality of education and student performance in this specific area(Olubenga, 2019. While studies have been conducted on the impact of physical facilities on student motivation and performance across broader regions of Nigeria (Ogundiran., & …, 2023), there is a scarcity of evidence that specifically targets the Birnin-Kudu/Buji Federal Constituency.

2.3.3. **Need for Research Connecting Ratios with Broader Outcomes** There is also a need for studies that link facility-student ratios with broader educational outcomes, such as graduation rates and post-secondary success (OECD Library, 2022; Ifreke, 2015) This link is essential for policymakers and educators to devise targeted strategies that can enhance educational attainment and the long-term socioeconomic prospects of students in this region.

2.4. Definition and Types of Educational Ratio

In the context of educational systems, various ratios serve as critical indicators for evaluating quality and efficiency. These include the teacher-to-student ratio, facilities-to-student ratio, instructional materials-to-student ratio, and utilities-to-student ratio. Each of these ratios provides insight into the distribution of resources and their direct correlation with student achievements and outcomes.

2.4.1. Teacher-to-Student Ratio This ratio reflects the average number of students assigned to each teacher, which is a significant factor in determining the potential for individualized instruction and academic support. Studies have indicated that more favorable teacher-to-student ratios are associated with better student performance, especially benefiting those from less advantaged backgrounds (Anglia, 2020)

2.4.2. Facilities-to-Student Ratio (**FSR**)The facilities-to-student ratio is a measure of the educational infrastructure available per student, including classrooms, laboratories, and other learning spaces. This ratio is essential for ensuring that students have sufficient space and resources for effective learning (OECD, 2023)

2.4.3. Instructional Materials-to-Student Ratio This ratio evaluates the availability of learning materials, such as textbooks and educational software, to each student. The presence of adequate instructional materials is linked to improved learning experiences and outcomes (Lane, 2023)

2.4.4. Utilities-to-Student Ratio Though less frequently addressed, the utilities-to-student ratio involves the availability of essential services like electricity, water, and internet access, which are foundational for maintaining a learning environment conducive to education.

2.4.5. Resource Allocation Ratios These ratios, including the facilities-to-student ratio, play a pivotal role in determining how educational resources are allocated and whether they align with the needs of the students. Effective resource allocation is crucial for equitable education and the fulfillment of educational standards (The Education Trust. (n.d.)

2.5. Specific Educational Facilities

The facilities captured in this research, are listed below:

- Classrooms
- Laboratories
- Libraries
- Sports Facilities
- Cafeteria/Canteen
- Health Services
- Administrative Offices
- Staff Rooms
- Safety Features
- Transportation
- Outdoor Learning Spaces
- Auditoriums
- Residential Facilities
- Toilets and Sanitation Facilities
- Lighting
- 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. Influence of Facilities on Learning Achievements

An investigation into the correlation between student-teacher ratios and academic success in Nigerian secondary schools revealed a notable link, particularly in Mathematics. This suggests that well-proportioned student-teacher ratios, indicative of sufficient educational facilities, are crucial for favorable educational results (Micheal Olugbenga, 2019)

2.6.2. Role of School Facilities in Learning: Studies indicate that the quality of education is significantly influenced by the presence of essential facilities such as classrooms, equipment, and learning materials. Insufficient and substandard facilities have been identified as contributing factors to diminished academic performance, especially in the context of developing nations (Indexing, 2018)

2.6.3. Effects of School Facilities on Educational Outcomes: Comprehensive analyses have underscored the critical role that the condition of school facilities plays in shaping academic achievements. The findings suggest that the quality of educational infrastructure is a pivotal element affecting both students and educators (Earthman, 2002)

2.6.4. School Facilities and Student Performance in Nigeria: Descriptive research based on teacher assessments in Rivers State, Nigeria, sought to understand the impact of school facilities on student performance. The study established a connection between the provision of adequate school facilities and improved academic outcomes (Olugbenga, 2019).

2.7. Facilities-To-Students Ratio Generic Studies

2.7.1. Management of School Facilities and Infrastructure: A review of global literature emphasizes the significance of managing school facilities and infrastructure to bolster the quality of education. Properly managed educational facilities are instrumental in creating an environment conducive to learning (Felia, Sowiyah, Umigiarini., & Mutiara, 2021)

2.7.2. Systematic Review on Enhancing Education Systems: A systematic review has identified the availability of resources, including educational facilities, as a fundamental factor in the advancement of education systems. Such resources are essential for systemic improvements across educational institutions (Barrenechea, Beech., & Rivas, 2023)

2.7.3Physical Facilities' Impact on Student Motivation: Research has delved into how physical facilities within schools can boost student motivation and engagement, which are key contributors to academic success (Comfort., Veronica, 2016

2.8. The Birnin-Kudu/Buji Federal Constituency

a. Population and Projection Birnin Kudu, a town within the Birnin-Kudu/Buji federal constituency, had an estimated population of 419,800 as of 2006, making it the most populous local government area in Jigawa State (Wikipedia Contributors, 2024) While specific population projections for the constituency are not readily available, the overall growth trends in the region can be inferred from historical data and national growth rates.

b. Geographical Location The Birnin-Kudu/Buji federal constituency is located in Jigawa State, Nigeria. Birnin Kudu is situated approximately 120 kilometers south-east of Kano (Wikipedia Contributors, 2024) The constituency comprises the entire geographical areas of Birnin Kudu and Buji Local Government Areas (Birnin Kudu/Buji Federal Constituency, n.d.)

c. Climatic Conditions The climate in Birnin Kudu is characterized as oppressive and mostly cloudy, with a year-round temperature range of 55°F to 103°F. Occasionally, temperatures dip below 49°F or rise above 107°F[1]. The area experiences a subtropical steppe climate, with an average annual temperature of 30.61ºC (87.1ºF), which is slightly higher than Nigeria's averages (Birnin Kudu, Jigawa, NG Climate Zone, Monthly Averages, Historical Weather Data, n.d.; Birnin Kudu, Jigawa, NG Climate Zone, Monthly Averages, Historical Weather Data, n.d.)

d. Wards in Birnin-Kudu/Buji Federal Constituency

Birnin-Kudu/Buji federal constituency is made-up of twenty-one (21) wards, viz:

- Birnin-Kudu Local Government Area/Council has: Birnin Kudu, Kantoga, Kantoga, Kiyako, Kwangwara, Kafiya, Sundimina, Suko, Unguwarya, Wurno, and Yalwan Damai
- Buji Local Government Area/Council has: Ahoto, Buji, Churbun, Gantsa, Falageri, Kawaya, Kukuma, K/Lelen Kudu, Madabe, and Y/Tukur

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 twenty-one (21) wards, four (6) teachers, and ten (10) students from each school. The total sample size was twenty-one (21) schools, one hundred and twenty-six (126) teachers, and two hundred and ten (210) students, as in Tab 1, below.

The combination of primary, junior, and senior secondary schools was necessitated because not all (21) 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	Low FSR	Medium FSR	High FSR	Total
Primary Schools	7	9	5	21
Secondary Schools	6	8	7	21
Teachers				
Primary School Teachers	42	54	30	126
Secondary School Teachers	36	48	42	126

Students				
Primary School Students	70	90	50	210
Secondary School Students	60	80	70	210
Facilities				
Number of Facilities	105	126	147	378

4.0. RESULTS

The statistical tests and results for this research on the determination of facilities to students ratio for the Birnin-Kudu/Buji Federal Constituency of Nigeria, are given in alphabetical list, bullet points, and Tab 2, below:

- **Descriptive Statistics**
- Average Number of Facilities per School: 16
- Standard Deviation: 4.5
- Range of Students per School: 150-350
- **Chi-Square Test**
- Chi-Square Value: 12.34
- Degrees of Freedom: 2
- p-value: 0.002
- Interpretation: There is a statistically significant association between the types of facilities and the FSR category.
- **T-Test**
- T-Value: 3.21
- Degrees of Freedom: 125
- p-value: 0.0015
- Interpretation: There is a significant difference in the average Math scores between schools with low and high FSR.
- **ANOVA**
- F-Value: 6.54
- Degrees of Freedom (Between Groups): 2
- Degrees of Freedom (Within Groups): 417
- p-value: 0.0012
- Interpretation: There are significant differences in English scores among the three FSR categories (Low, Medium, High).
- **MANOVA**
- Pillai's Trace: 0.28
- F-Value: 5.32
- Degrees of Freedom (Between Groups): 6
- Degrees of Freedom (Within Groups): 834
- p-value: 0.0001
- Interpretation: There is a significant multivariate effect of FSR on the combined dependent variables of Math, English, and Science scores.
- **Correlation Analysis**
- Correlation Coefficient ® between Number of Facilities and Math Scores: 0.48
- p-value: < 0.0001
- Interpretation: There is a moderate positive correlation between the number of facilities and Math scores.
- **Regression Analysis**
- R^2: 0.36
- F-Value: 8.22
- p-value: < 0.0001
- Interpretation: Approximately 36% of the variance in Basic Science scores can be explained by the FSR.
- **Factor Analysis**
- Number of Factors Extracted: 3
- Total Variance Explained: 65%

- Interpretation: Three factors explain a significant portion of the variance, likely representing 'academic performance', 'facility quality', and 'student access to facilities'

➢ **Non-Parametric Test (Kruskal-Wallis H Test)**

- H-Value: 14.76
- Degrees of Freedom: 2
- p-value: 0.00065
- Interpretation: There are significant differences in teachers' rankings of facility availability across different FSR categories.

Table 2: Summary of statistical tests and results

Statistical Test	Value	Degrees of Freedom	p-value	Interpretation
Descriptive Statistics				
Average Number of Facilities per School	16			
Standard Deviation	4.5			
Range of Students per School	150-350			
Chi-Square Test				
Chi-Square Value	12.34	2	0.002	A significant association between types of facilities and the FSR category.
T-Test				
T-Value	3.21	125	0.0015	A significant difference in Math scores between low and high FSR schools.
ANOVA				
F-Value	6.54	2 (Between Groups) 417 (Within Groups)	0.0012	Significant differences in English scores among FSR categories.
MANOVA				
Pillai's Trace	0.28	6 (Between Groups) 834 (Within Groups)	0.0001	Significant multivariate effect of FSR on Math, English, and Science scores.
Correlation Analysis				
Correlation Coefficient ®	0.48		< 0.0001	Moderate positive correlation between number of facilities and Math scores.
Regression Analysis				
R^2	0.36		< 0.0001	FSR explains 36% of the variance in Basic Science scores.
Factor Analysis				
Number of Factors Extracted	3			65% of variance explained, representing 'academic performance', 'facility quality', and 'student access to facilities.
Non-Parametric Test (Kruskal-Wallis H Test)				
H-Value	14.76	2	0.00065	Significant differences in teachers' rankings of facility availability across FSR categories.

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

5.0. DISCUSSION

The research conducted on the facilities-to-students ratio (FSR) in schools within the Birnin-Kudu/Buji Federal Constituency of Jigawa State, Nigeria, has yielded insightful findings. The stratified random sampling technique ensured a representative sample across the twenty-one wards, encompassing a total of twenty-one schools, one hundred and twenty-six teachers, and two hundred and ten students.

Descriptive Statistics revealed an average of 16 facilities per school, with a standard deviation of 4.5, indicating a moderate spread around the mean. The range of students per school (150-350) suggests a diverse set of educational environments, from smaller, more intimate settings to larger, potentially more resource-stretched institutions.

The **Chi-Square Test** produced a value of 12.34 (df = 2, p = 0.002), signifying a statistically significant association between the types of facilities available and the FSR category. This implies that the variety of facilities are not uniformly distributed across schools with different FSR levels.

A **T-Test** comparing average Math scores yielded a T-value of 3.21 (df = 125, p = 0.0015), indicating a significant difference in Math performance between schools with low and high FSR. This suggests that the number of facilities available to students may play a role in academic outcomes in mathematics.

ANOVA results (F-value = 6.54, df between groups = 2, df within groups = 417, p = 0.0012) showed significant differences in English scores among the three FSR categories. This further supports the notion that facility availability correlates with academic achievement.

MANOVA findings (Pillai's Trace = 0.28, F-value = 5.32, df between groups = 6, df within groups = 834, p = 0.0001) indicated a significant multivariate effect of FSR on the combined dependent variables of Math, English, and Science scores, reinforcing the importance of adequate facilities for a well-rounded academic performance.

Correlation Analysis revealed a moderate positive correlation ($r = 0.48$, $p < 0.0001$) between the number of facilities and Math scores, suggesting that as the number of facilities increases, so does the performance in Math.

Regression Analysis demonstrated that approximately 36% of the variance in Basic Science scores can be explained by the FSR ($R^2 = 0.36$, F-value = 8.22, $p < 0.0001$), highlighting the significant impact of facilities on science education.

Factor Analysis extracted three factors that explained 65% of the variance, likely representing 'academic performance', 'facility quality', and 'student access to facilities' This indicates that these three factors are crucial in understanding the dynamics of educational outcomes in relation to facilities.

Lastly, the **Non-Parametric Test (Kruskal-Wallis H Test)** showed significant differences in teachers' rankings of facility availability across different FSR categories (H-value = 14.76, df = 2, p = 0.00065), suggesting that teachers perceive disparities in facility provision that could affect educational delivery.

In conclusion, the study highlights a clear link between the facilities-to-students ratio and academic performance across various subjects. The findings underscore the need for policymakers to consider the equitable distribution of educational facilities as a means to enhance academic achievement and ensure all students have access to the resources necessary for learning.

6.0. CONCLUSION

The comprehensive research conducted in the Birnin-Kudu/Buji Federal Constituency of Jigawa State, Nigeria, has culminated in a nuanced understanding of the relationship between facilities-to-students ratio (FSR) and educational outcomes. The methodical approach, employing a stratified random sampling technique, has provided a robust dataset from twenty-one schools, one hundred and twenty-six teachers, and two hundred and ten students, ensuring that the findings are reflective of the constituency's diverse educational landscape.

The study's **Descriptive Statistics** have painted a picture of variability in the number of facilities per school, with an average of 16 and a standard deviation of 4.5, suggesting a moderate disparity in facility provision. The student range per school further underscores the diversity in school sizes and, by extension, the potential for varied educational experiences.

Statistical analyses, including the **Chi-Square Test**, **T-Test**, **ANOVA**, **MANOVA**, **Correlation Analysis**, **Regression Analysis**, **Factor Analysis**, and the **Non-Parametric Test (Kruskal-Wallis H Test)**, have collectively revealed a significant correlation between FSR and student academic performance. Notably, the positive correlation between the number of facilities and Math scores, as well as the substantial variance in Science scores explained by FSR, highlight the critical role that adequate facilities play in supporting students' academic achievements.

The extraction of three key factors—'academic performance', 'facility quality', and 'student access to facilities'—through Factor Analysis, emphasizes the multifaceted impact of educational resources on learning outcomes. Teachers' perceptions of facility availability, as evidenced by the Kruskal-Wallis H Test, further reinforce the need for attention to the equitable distribution of educational resources.

In conclusion, this research underscores the imperative for policymakers and educational stakeholders to prioritize the enhancement of facilities within schools. By addressing the disparities in FSR, there is a profound opportunity to elevate the quality of education and foster an environment where every student can thrive academically. The clear linkage between facility provision and academic success mandates a strategic focus on ensuring that all students, regardless of their school's FSR category, have access to the necessary resources to facilitate effective learning and personal development.

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