



An Evaluation of the Impact of Selected Teaching Methods on the Academic Performance of Nursing Students in Biostatistics at Schools of Nursing Akwa Ibom State

¹Dr. Anietie Mary Udo, ²Dr. Elusoji I. Christiana, ³Dr. Oko-Ose N. Josephine, ⁴Dr. Akpan Paulina A. Akpan-Idiok, ⁵Eweka Abieyuwa, ⁶Dr. E. Basse Immaculate, ⁷Dr. Munge F. Mary, ⁸Agogo Roseline Ufuoma, ⁹Etim Patricia Patrick, ¹⁰Emina Awuli and ¹¹Agogo Roseline Ufuoma

¹College of Nursing Sciences Akwa Ibom State College of Science, ANUA Campus Uyo, Nigeria

²Nursing Sciences, College Health Sciences Benson Idahosa University, Edo State Nigeria

^{3,7,10}Department of Nursing Sciences, College Health Sciences Benson Idahosa University, Edo State Nigeria

⁴Department of Nursing Sciences, Faculty of Allied Health Sciences University of Uyo, Akwa Ibom State Nigeria

⁵College of Nursing Sciences, University of Benin Teaching Hospital, Edo State Nigeria

⁶Nursing Sciences, Faculty of Basic Medical Sciences, Igbinedion University Okada, Edo State Nigeria

^{8,11}Department of Nursing science, Faculty of Applied Health Western Delta University Oghara Delta state Nigeria

⁹Department of Nursing, Faculty of Applied Health Western Delta University Oghara Delta state Nigeria

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Corresponding Author

Dr. Anietie Mary Udo,
College of Nursing Sciences Akwa
Ibom State College of Science, ANUA
Campus Uyo, Nigeria

Author Designation

^{1,2,6}Head of Department

^{3,4,7,9}Senior Lecturer

⁵Lecturer

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ABSTRACT

The primary goal of teaching is to facilitate meaningful change in learners. Traditional teaching methods have often been teacher-centered, resulting in passive learning where students receive information without engaging with the material. This study aimed to evaluate the impact of various teaching methods on nursing students' performance in Biostatistics at Schools of Nursing in Akwa Ibom State. Utilizing a quasi-experimental pre-test, post-test, control group design, the researcher developed a Biostatistics Achievement Test for data collection. The sample included 120 second-year nursing students, evenly distributed across three schools, with no sampling technique employed. All students participated in both pre and post-tests, and groups were assigned based on their respective schools. Data analysis involved descriptive statistics (frequency, percentages, means, and standard deviation) and inferential statistics (paired t-test, ANOVA). Indicated that most respondents were aged 18-23, female, and single. Teaching methods positively influenced students' performance in Biostatistics. Pre-test scores showed no significant differences among the flipped classroom (11.75 ± 3.8), cooperative learning (10.30 ± 2.00), and lecture methods (10.45 ± 2.12). However, post-test scores revealed significant improvements, particularly in the flipped classroom method (40.08 ± 2.97), outperforming both cooperative learning (35.45 ± 5.77) and lecture methods (29.30 ± 4.45). The study concluded that both flipped classroom and cooperative learning methods enhance student performance and recommended their adoption to improve academic outcomes and social interaction skills among nursing students.

INTRODUCTION

Education is fundamental to national development, serving as the foundation for progress across various sectors of a nation's economy^[1]. It is a crucial process in human development, encompassing the impartation of knowledge, training of faculties, and development of skills^[2]. Education is a cumulative process that shapes intellectual abilities, skills, and attitudes, influencing individuals' outlooks and actions throughout life. Given the global emphasis on education as a pathway to success, it is essential to adopt effective teaching methods that fulfill educational objectives.

Teaching methods are pivotal to the success of educational systems^[3]. The choice of teaching methods significantly impacts students' academic performance^[4]. These methods encompass the strategies teachers employ to achieve educational goals, including instructional organization, techniques, subject matter, and the use of teaching materials^[5]. An instructor's understanding of effective teaching methods can enhance student motivation and improve teaching efficiency^[6]. Teaching methods range from traditional exposition to more interactive inquiry-based approaches. The exposition method, which is conventional and widely used, is characterized by a teacher-centered approach where the instructor actively leads while students remain passive. Examples include lectures, discussions, and demonstrations. In contrast, inquiry-based methods encourage students to generate their own information, fostering active participation and emphasizing the learning process. Examples of inquiry methods include flipped classrooms, cooperative learning, problem-solving, and guided inquiry^[7].

The flipped classroom model involves transferring traditional teaching outside the classroom through online videos, allowing students to engage with content at their own pace^[8]. This approach transforms class time into workshops where students can test their knowledge through inquiry and discussion, with teachers acting as facilitators^[9]. The flipped classroom aligns with Bloom's taxonomy, enabling students to engage in higher-order thinking during class while lower-level cognitive tasks are completed independently^[10]. Previous studies have indicated that the flipped classroom can enhance self-paced learning, content retention, and student interest^[11]. However, its effectiveness in medical education remains debated, with some studies suggesting it may not improve performance in complex subjects like neuroanatomy^[11]. Thus, evaluating the flipped classroom's impact on nursing students' performance in Biostatistics is crucial.

Cooperative learning is another instructional method where students work in small groups to achieve common learning goals under teacher guidance^[12]. This approach fosters social constructivism, allowing students to take ownership of their learning^[13]. The interactive nature of cooperative learning promotes student-to-student and teacher-to-student learning, enhancing instructional practices^[13]. It not only aids comprehension but also develops self-confidence and self-directed learning skills through collaborative processes^[13,14]. Cooperative technologies play a significant role in education, helping students develop interpersonal and intrapersonal skills necessary for real-world collaboration^[15]. Active participation in cooperative learning settings, such as group presentations and discussions, enhances students' expertise and success in various contexts^[16]. Despite the recognition of cooperative learning as an effective pedagogical technique, further empirical research is needed to compare its effectiveness with traditional lecture models.

Lecturing, a traditional instructional method, involves an instructor delivering information verbally to students^[16]. However, its effectiveness has been challenged in light of more interactive methods^[17]. Critics argue that the lecture method may fail to engage students and lacks the interactivity of modern teaching approaches^[18]. While lectures may be more passive than collaborative learning, they can still foster some level of engagement compared to independent reading^[19]. Comparative studies have examined the effectiveness of lecture versus cooperative learning in various subjects, including mathematics^[20]. These studies highlight the need for further research to assess the effectiveness of cooperative learning in specific disciplines, such as mathematics and Biostatistics.

In the medical field, there is a growing trend to move away from lecture-based instruction in favor of collaborative learning and problem-based approaches^[21]. While these researchers did not conduct a comparative assessment, they noted a preference for cooperative learning techniques among students and faculty. This trend underscores the need for further investigation into the differences between teaching methods, particularly in nursing education.

In effective teaching methods in Biostatistics can significantly impact students' academic performance, especially when they struggle with complex statistical concepts^[22].

MATERIALS AND METHODS

Design: Research design is the strategic framework that researchers use to integrate study components

and address research questions effectively^[23]. It serves as a blueprint for data collection and analysis, encompassing plans and methods for investigating research problems^[24]. Research designs are categorized into quantitative and qualitative approaches, with quantitative methods focusing on measurement and statistical analysis^[25]. This study employed a quasi-experimental, pre-test, post-test, control group design, involving two experimental groups (flipped classroom and cooperative learning) and a control group (lecture method) to assess educational outcomes.

Study Area: The study was conducted in the three Schools of Nursing in Akwa Ibom State, Nigeria, located in the South-South geopolitical zone. Akwa Ibom, created from Cross River State in 1987, is bordered by several states and the Atlantic Ocean, with Uyo as its capital. The state is rich in mineral resources and is Nigeria's largest oil producer, with a diverse economy that includes agriculture, fishing, and crafts. Akwa Ibom has 19 accredited higher institutions, including three Schools of Nursing, which collectively serve 514 students. Each school is led by a Principal and has an academic staff of 16-20, maintaining a student-to-staff ratio of at least 1:15.

Study Population: The study's population consisted of all nursing students in Akwa Ibom State, totaling 514 students across three schools. This target population represents the group of individuals with specific characteristics relevant to the research, from which a sample is drawn for analysis^[26].

Sample Size: A sample is a manageable representation of a larger population, used in statistical testing when the population is too large to include all participants^[27]. This study involved a total population sample of 120 second-year nursing students from three schools, ensuring all were included due to the relevance of Biostatistics.

Total Population Sampling: Total population sampling is a purposive sampling technique where researchers examine the entire population with specific characteristics. This method is particularly useful when the population is small or shares uncommon traits, as omitting even a few participants could lead to significant gaps in understanding. According to Perez (2020), advantages include the ability to generalize findings and analyze data comprehensively. However, it is less suitable for larger populations or when participation is incomplete, which can compromise the validity of generalizations^[28]. In this study, total population sampling was employed due to the small size of the

nursing student population, ensuring all respondents were included in the Biostatistics course^[29].

Sampling Technique: This study employed a total population sampling technique, meaning no specific sampling method was used. All fresh second-year first-semester nursing students from the three Schools of Nursing in Akwa Ibom State were included: 40 students from School of Nursing Anua, 40 from School of Nursing Eket, and 40 from School of Nursing Ikot Ekpene.

Instrument for Data Collection: Data collection is a systematic process for gathering observations and measurements, providing researchers with firsthand insights into their research problems^[30]. In this study, a researcher-developed Biostatistics Achievement Test (BAT) was used, with items derived from an Instructional Package on Biostatistics (IPB) and a Teaching Plan (TP). The instructional package included three units covering topics such as the role of statistics in healthcare, statistical measurements, and statistical analysis. Students were taught using different methods: flipped classroom, cooperative learning, and traditional lectures. The researcher trained assistants in these methods and supervised their teaching over 12 weeks, ensuring confidentiality and voluntary participation. Pre-tests were administered to assess prior knowledge, and achievement tests were used for data collection, similar to instruments used in previous studies.

Experimental Group One: School of Nursing Anua, Uyo. (Flipped Classroom Method): Students in the experimental group were taught Biostatistics using a flipped classroom approach. A pre-test, the 50-item Biostatistics Achievement Test (BAT), was administered before the intervention. Lecture notes were recorded and sent via WhatsApp, allowing students to study at their own pace on topics like basic concepts and statistical measurements. In class, students discussed these topics, asked questions, and received guidance from the researcher. After twelve weeks, a post-test using the same BAT assessed their academic performance.

Experimental Group Two (Cooperative Learning Method): In experimental group two, students learned Biostatistics through a cooperative learning method facilitated by a trained research assistant. They were divided into small groups of 4-5, where they collaborated on topics derived from the IPB. Each member worked independently while discussing, presenting, analyzing, and synthesizing the material. The group dynamic fostered motivation and support,

Table1: showing schools, number of students and sample

S/n	Schools	Number of students	Sample (first semester second year students)
1.	School of nursing, st luke's hospital anua, uyo. (flipped classroom method)	173 students	40
2.	School of nursing, immanuel general hospital, eket. (cooperative learning method)	171 students	40
3.	Central school of nursing and midwifery, ikot ekpene. (lecture method of teaching).	170 students	40
	Total	514	120

Table 2: Demographic characteristics of the students

Demographic Characteristics	No of Students (n=120)	Percentage(%)
Age (years)		
18-23	58	48.3
24-29	46	38.3
=30	16	13.3
Mean ±SD	23.9±3.8	
Gender		
Male	17	14.2
Female	103	85.8
Marital Status		
Single	103	85.8
Married	17	14.2
School		
School of Nursing, Eket	40	33.3
School of Nursing, Anua	40	33.3
Central School Of Nursing & Midwifery, Ikot Ekpene	40	33.3

Table 3: Effect of teaching methods on the performance of nursing students in Biostatistics in Schools of Nursing Akwa Ibom State.

Teaching Methods	Pre-test Average Score	Post-test Average Score	Mean Difference	P-values
Flipped Classroom Method	11.75±3.87	40.08±2.97	28.33	<0.001
Cooperative Learning Method	10.30±2.00	35.43±5.77	25.13	<0.001
Lecture Method	10.45±2.12	29.30±4.85	18.85	<0.001
Total Mean score	10.83±2.85	34.93±6.42	24.10	

enhancing understanding. Class time was dedicated to group presentations, with the tutor guiding discussions and clarifying concepts. Students engaged in hands-on activities, such as calculating mean, median, and creating charts. A post-test, the 50-item Biostatistics Achievement Test (BAT), was administered after twelve weeks to assess their mastery of the content.

Control Group: The control group received Biostatistics instruction through traditional lectures by a research assistant for two hours, three times a week, over twelve weeks. Lectures covered curriculum topics, with students taking notes. A pre-test and post-test (50-item Biostatistics Achievement Test) were administered to evaluate academic performance and participation.

Biostatistics Achievement Test (BAT): Achievement tests are commonly utilized in educational settings to assess students' readiness for specific grade levels or subjects^[31]. Standardized tests help determine if educational standards are being met by schools, teachers, and students. The Biostatistics Achievement Test used in this study comprised 50 multiple-choice items covering key concepts such as the role of statistics in healthcare, data collection, measures of central tendency, and statistical computing with software like SPSS. This test was administered before and after the intervention to both experimental and control groups. Previous studies, such as those by

Mwangi (2017) and Omeodu (2019), also employed achievement tests to evaluate the impact of cooperative learning strategies on students' academic performance in various subjects, confirming the instrument's relevance^[32].

Validity of Instrument: Validity refers to the extent to which a measuring instrument accurately assesses the behavior or quality it is intended to measure^[33]. It involves meaningful interpretation of data obtained from the instrument. Types of validity include construct, content, face, and criterion validity (Middleton, 2020). In this study, the Biostatistics Achievement Test was evaluated for face and content validity by experts from the Faculty of Health Sciences and Technology at Ebonyi State University. Their feedback on item clarity and appropriateness was incorporated, resulting in a content validity index (CVI) of 0.93, confirming the instrument's validity.

Reliability of Instrument: Reliability refers to the stability and consistency of a measuring instrument over time, indicating its ability to yield similar results when applied at different times^[33]. While variations may occur due to changes in the population or sample, a strong positive correlation between results suggests reliability. Researchers can assess reliability through methods such as test-retest, alternative forms, and internal consistency tests^[34]. In this study, the Biostatistics Achievement Test (BAT) was

administered to first-semester nursing students in Calabar, with a test-retest method applied to 24 students. A reliability coefficient of 0.80 was obtained, confirming the instrument's high reliability.

Ethical Considerations: For this study, the researcher submitted an application for ethical approval to the Ethical Committee of the Ministry of Health, Akwa Ibom State, along with an informed consent form detailing the study's purpose, procedures, risks, and confidentiality. Approval was granted, and participants were assured of their voluntary participation and anonymity.

Procedure for Data Collection: Data collection is a systematic process of gathering observations or measurements to gain insights into a research problem^[35]. It involves various methods, such as surveys and interviews, and requires a clear understanding of the data needed. In this study, data was collected through face-to-face administration of the Biostatistics Achievement Test in a classroom setting.

Pretest: The researcher administered a pretest on the first day of meeting with students to assess their prior knowledge of Biostatistics using the Biostatistics Achievement Test (BAT), which consisted of 50 structured items worth 100%. This pretest was conducted for all students in the experimental and control groups before the intervention. The pretest mean score established a baseline for comparing performance. After the intervention, a posttest was administered using the same instrument, with data collection spanning 12 weeks.

Procedure for Data Analysis: Data analysis involves cleaning and processing raw data to extract actionable information, aiding researchers in informed decision-making^[36]. This process includes gathering, exploring, and identifying patterns in the data. In this study, both descriptive statistics (frequencies, percentages, mean, and standard deviation) and inferential statistics (paired t-test, ANOVA) were used to analyze the data at a 0.05 significance level, utilizing the Statistical Package for the Social Sciences (SPSS) for analysis.

Demographic Characteristics of Students: The demographic variables were analyzed using descriptive statistics such as; frequencies, percentages, mean, standard deviation and presented in tables.

RESULTS AND DISCUSSIONS

This dealt with the presentation of the results of data collected during the study guided by research

objectives and hypotheses.

Table 4.1 presents the Demographic characteristics of the students. About half of the students (48.3%) are in age 18-23years, while those of 30years and above were the least (13.3%). Their mean age and standard deviation age is 23.9 ± 3.8 years. Also, majority of the students (85.8%) are female and single equally. The study participants are evenly distributed among the three schools (33.3%) each.

Teaching methods positively impacted nursing students' performance in Biostatistics in Akwa-Ibom State. The flipped classroom method improved average scores by 28.33 marks, cooperative learning by 25.13 marks, and the lecture method by 18.85 marks. Overall, the teaching methods increased students' performance by an average of 24.10 marks.

Test of Hypotheses: Hypothesis 1 is rejected ($P < 0.05$) and therefore concluded that teaching method has statistically significant effect on the performance of students in Biostatistics in schools of nursing, Akwa-Ibom State. This implies that different teaching method enhances the performance of the nursing students in Biostatistics.

Hypothesis 2 is rejected, because there is significant difference in the performance of students taught Biostatistics using flipped classroom method of teaching (40.08 ± 2.97) and students taught using lecture method (29.30 ± 4.85) in Schools of Nursing, Akwa Ibom State ($P < 0.05$). This showed that the students taught Biostatistics using flipped classroom method of teaching (40.08 ± 2.97) performed better than the students taught using lecture method (29.30 ± 4.85).

Hypothesis 3 is rejected, because there is significant difference in the performance of students taught Biostatistics using cooperative learning method of teaching (35.43 ± 5.77) and students taught using lecture method (29.30 ± 4.85) in Schools of Nursing, Akwa Ibom State ($P < 0.05$). This showed that the students taught Biostatistics using cooperative learning method of teaching (35.43 ± 5.77) performed better than the students taught using lecture method (29.30 ± 4.85).

This study aimed to assess the impact of selected teaching methods on nursing students' academic performance in Biostatistics at schools in Akwa Ibom State. Effective teaching is crucial for student development and engagement, particularly in a student-centered learning environment. The study found that the flipped classroom method improved average scores by 28.33 marks, cooperative learning by 25.13 marks, and traditional lectures by 18.85 marks, with an overall increase of 24.10 marks across methods. The findings align with previous research highlighting the benefits of

Table 4: Hypothesis 1: Teaching method has no statistically significant effect on the academic performance of students in Biostatistics in schools of nursing, Akwa-Ibom

Teaching Methods	Pre-test Average Score	Post-test Average Score	t-test	P-value
Flipped Classroom Method	11.75±3.87	40.08±2.97	36.055	<0.001
Cooperative Learning Method	10.30±2.00	35.43±5.77	26.462	<0.001
Lecture Method	10.45±2.12	29.30±4.85	24.066	<0.001
Total Mean score	10.83±2.85	34.93±6.42	37.577	<0.001

Table 5: Hypothesis 2: There is no significant difference in the academic performance of students taught Biostatistics using flipped classroom method of teaching and students taught using lecture method in Schools of Nursing, Akwa Ibom State

Teaching Methods	Performance of Students	
	Pre-test	Post-test
Flipped Classroom Method	11.75±3.87	40.08±2.97
Lecture Method	10.45±2.12	29.30±4.85

Analysis of Variance Table

Source	Sum of Squares	Df	Mean Square	F-ratio	P-value
Corrected Model	2325.351a	2	1162.675	71.175	0.000
Intercept	6596.454	1	6596.454	403.810	0.000
Teaching method	2187.642	1	2187.642	133.919	0.000
Pre-test	3.338	1	3.338	0.204	0.652
Error	1257.837	77	16.336		
Total	99841.000	80			
Corrected Total	3583.188	79			

a. R Squared = 0.649 (Adjusted R Squared = 0.640)

Table 6: Hypothesis 3: There is no significant difference in the academic performance of students taught Biostatistics using cooperative learning method and students taught using lecture method in Schools of Nursing in Akwa Ibom State.

Teaching Methods	Performance of Students	
	Pre-test	Post-test
Cooperative Learning Method	10.30±2.00	35.43±5.77
Lecture Method	10.45±2.12	29.30±4.85

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-ratio	P-value
Corrected Model	776.621a	2	388.310	13.641	0.000
Intercept	2576.809	1	2576.809	90.523	0.000
Teaching method	759.660	1	759.660	26.687	0.000
Pre-test	26.308	1	26.308	0.924	0.339
Error	2191.867	77	28.466		
Total	86755.000	80			
Corrected Total	2968.487	79			

a. R Squared = 0.262 (Adjusted R Squared = 0.242)

innovative teaching strategies, such as those by Abulhul (2021) and Amin and Raba (2022), which emphasize active learning. However, contrasting results from Cordero and Gil-Izquierdo (2018) suggest traditional methods can also be effective, depending on context. Overall, the study underscores the importance of diverse teaching approaches in enhancing nursing students' understanding of Biostatistics, ultimately contributing to their professional competence in healthcare^[37].

The study found that pretest scores for both the flipped classroom (11.75±3.87) and lecture method (10.45±2.12) were similar, indicating comparable baseline knowledge among students. However, posttest scores revealed significant improvement, with the flipped classroom method yielding a mean score of 40.08±2.97 compared to 29.30±4.85 for the lecture method. This enhancement in performance is attributed to the flipped classroom's emphasis on student-centered learning, increased engagement, and the ability for students to review materials at their own pace. The method promotes technology use, differentiates instruction, and fosters better student-teacher relationships. Findings align with

previous research by Aristotle *et al.* (2021) and El-Sheikh and El-Sayad (2019), which also highlighted the effectiveness of flipped classrooms. The study supports Bloom's Revised Taxonomy, as it allows students to progress from lower-level tasks, like remembering, to higher-level tasks, such as applying and creating, during class time, enhancing overall learning outcomes^[38].

CONCLUSION

This study found that the flipped classroom learning method significantly improved students' performance in Biostatistics, while the cooperative learning method also yielded similar enhancements. Both methods foster active participation and interaction among students, suggesting they can be used interchangeably. The study concluded that combining instructional methods, particularly flipped classroom and cooperative learning, effectively boosts performance in Biostatistics in nursing schools in Akwa Ibom State. Consequently, it is recommended that nursing schools incorporate either or both methods alongside traditional lectures when teaching Biostatistics to enhance student learning outcomes.

Recommendations: Based on the research findings, several recommendations were made:

- Biostatistics lecturers should implement flipped classroom and cooperative learning to enhance student performance and social interaction.
- Schools should organize workshops to familiarize educators and students with these methods.
- Tutors should combine multiple teaching techniques for effective learning.
- Educators must improve their knowledge of instructional strategies through professional development.
- Teacher education programs should include flipped classroom and cooperative learning methods.
- The government should provide ongoing training for instructors.
- Biostatistics should be taught using student-centered methods, with follow-up studies to assess outcomes.
- Curriculum planners should revise curricula to incorporate effective teaching strategies that promote student engagement.

Implication for Nursing: The study demonstrates that student-centered learning methods, like flipped classrooms and cooperative learning, yield better learning outcomes than traditional lectures, highlighting the need for nurse educators to adopt effective teaching strategies.

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Competing Interests: The authors declare that they do not have any conflicts of interest.

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