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Effects of Problem Based Learning Technique on Preliminary Training School Nursing Students Performance in Introductory Examination in Plateau State, Nigeria

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Abstract

The Plateau State College of Nursing Sciences has observed a persistent decline in the academic performance of students enrolled in the Preliminary Training School (PTS) nursing program, raising concerns among educators and administrators. From 2017 to 2023, the percentage of students completing their introductory examinations fluctuated between 19.5% and 40%, reflecting a significant trend of academic underachievement and subsequent program dismissals. This study investigates the impact of the Problem-Based Learning (PBL) technique on the academic performance of PTS nursing students at Plateau State College of Nursing Sciences, Vom, Nigeria. Utilizing a quasi-experimental design, the study compares an experimental group exposed to PBL with a control group taught through traditional methods. Data analysis employed Analysis of Covariance (ANCOVA) to control for baseline performance differences. The results indicate a statistically significant improvement in academic performance among students in the PBL group, as evidenced by higher post-test scores compared to the control group. PBL was found to enhance critical thinking and problem-solving skills, contributing to academic success. Gender disparities were noted, with female students outperforming their male counterparts and displaying greater enthusiasm for the nursing profession. These findings underscore the need for inclusive, gender-sensitive, and culturally responsive teaching strategies to promote equitable learning environments. The study concluded that, while PBL is effective in enhancing academic achievement, a holistic approach is essential to foster genuine interest and passion for the nursing profession. These findings have important implications for curriculum design and policy development in nursing education.

Keywords: Effects, Problem based learning technique, Nursing students, Performance, Introductory Examination

Introduction

According to records from Plateau State College of Nursing Sciences' Examinations Department, 105 PTS nursing students appeared for the introductory tests in 2017, with just 40% of students clearing all components of the examinations. 123 PTS nursing students took the introduction tests in 2018, with just 19.5% clearing all courses. Furthermore, 113 PTS nursing students appeared for the introduction tests in 2022, with 20% of candidates clearing all sections of the examinations, while 35.5% of applicants failed in four subjects and were removed from the program due to low academic performance. In addition, 149 PTS nursing students took the introduction examinations in April 2023, with 39.6% clearing all papers whereas, 40.9% of applicants failed four or more papers.

The poor academic performance of PTS nursing students may result from various factors, which may include anxiety, the academic ability of students, the method of instruction used for the teaching, the attitude of both teachers and students toward academics, teachers' commitment, and parents' belief, among others. Efforts have been made by the Plateau State Government to improve the intake of students and the training of more nurses in the state through the training and retraining of teachers on more methods of teaching, employment of more nursing educators, provision of accommodation for students among others, but yet the statistics show that the student's performance in PTS is still not encouraging.

The implications of students' ongoing low performance in the PTS introductory examinations are that few nurses are trained and this has continued to affect the health sector because of the dearth of nurses. Hence, a necessity for research on the benefits of a problem-based learning approach in preliminary training school nursing students' interest and achievement in introductory tests in Plateau state, Nigeria. The researcher is not aware of any current attempt aimed at enhancing students' interest and success in PTS examination using problem-based learning methods. Hence the necessity to fill this gap.

This demand for coordinated effort is targeted at increasing the performance of students utilizing current ways of teaching such as problem-based learning methodology. Problem-based learning (PBL) in nursing student preliminary training provides numerous benefits, including improved critical thinking skills, improved knowledge retention, increased motivation and engagement, development of interpersonal and teamwork skills, increased confidence, and better preparation for clinical practice (Aiken et al., 2023). These benefits could impact students' interest in nursing and academic achievement in introductory examinations, thus better preparing them for their future professions as healthcare professionals.

The Preliminary Training School (PTS) nursing introduction tests encompass a wide variety of courses and talents that are essential for students to emerge as registered nurses. These courses are human anatomy and physiology, basic science, professionalism and ethics. The nursing examinations conducted in the Preliminary Training School (PTS) have a large effect on the training and competency of prospective nurses. It evaluates core competencies and knowledge (Alharbi, 2018). Furthermore, the exams offered to PTS nursing students offer a methodical examination of the student's aptitude in a lot of nursing activity areas, along with communication techniques, medical abilities, and decision-making. These examinations test how successfully college students can apply their theoretical know-how to practical clinical settings, assesses clinical practice, verifying that they have got the talents essential to give patients quality nursing

services (National Council of State Boards of Nursing. 2019). According to research by (Anderson and Davis 2019, and Liu et al. 2021), nursing students are more likely to interact in self-directed learning once they have been involved in the subject topic, which moved up their retention of vital ideas and statistics. It has been shown that participation in the instruction permits nursing college students to feel less anxiety in examinations. Students who were interested in the topic rely have been much less likely to experience test-associated tension, which might certainly impair examination overall performance, in agreement with studies by way of (Turner et al. 2017, Brown and Parker 2020, Brown 2017).

Therefore, the study set out to address the general question, what is the influence of a problem-based learning approach on preliminary training school nursing students' achievement in introductory examinations in Plateau State, Nigeria?

Specific objectives of the study were:

1. To determine students' achievement before and after being exposed to problem-based learning techniques in Plateau State College of Nursing Sciences, Vom, Plateau-Nigeria
2. To assess the students' performance based on gender before and after exposure to problem-based learning technique in Plateau State College of Nursing Sciences Vom, Plateau-Nigeria

Methodology

A total of 240 PTS nursing students from two distinct institutions under the Plateau State College of Nursing Sciences Vom were included. Split equally with 120 students each from the School of Nursing Jos and the School of Nursing Vom, one institution was served as the control group while the other was designated as the experimental group. The sampling process involved did not use simple random sampling since the schools are only two but used Hat and draw method to ensure that each school has an equal opportunity to be selected for experimental group. The inclusion criteria for participating in the study encompassed PTS nursing students who express willingness to partake, have completed the enrollment process, and return to class within a month of the program's commencement. Conversely, exclusion criteria encompassed students who decline participation, did not complete their registration, or resume classes more than a month after the program's initiation.

Data collection for the study was revolved around students' interest in the introductory exam, facilitated through two key instruments: the Preliminary Training School Nursing Students Achievement Tests (PTSNSAS) which has 50 objective questions. Validity checks, both face and content, was conducted on the PTSNSAT to ensure the reliability and effectiveness of the instruments. While content validity assesses the sufficiency and coverage of content within the items, face validity focuses on the appearance and layout of the instrument. To gauge the relevance and linguistic clarity of the PTSNSAT, instrument validators with substantial experience will review it. Additionally, retests were administered to evaluate the reliability of the instruments, with a two-week interval before their official administration to the student population. A program designed to train research assistants was established to provide support in the administration of instruments and specific topic instruction.

This treatment initiative was span a duration of ten weeks and encompassed a wide array of subjects, such as information computer technology, anatomy and physiology, nutrition, applied

chemistry, applied physics, English language usage, and the foundational principles of nursing. The experimental group, consisting of six students per group, were exposed to the problem-based learning (PBL) method, which is anticipated to enhance their learning outcomes significantly. Conversely, the control group was not be exposed to the PBL approach during their regular lecture sessions. To evaluate the effectiveness of the intervention, post-tests were administered to the PTS nursing students in both the experimental and control groups. To mitigate instances of malpractice, the PTSNSAT assessments were conducted in a standard PTS examination environment. The PTSNSAT was evaluated based on the responses provided by the students and the mean of the responses for each item. The collection of data for the study involved the utilization of achievement examinations and self-development questionnaires.

To conduct an initial analysis, self-development surveys, and achievement assessments were employed in this research project to gather pertinent information. The data obtained were meticulously entered into a structured database, where it was coded using either alphanumeric or numerical labels and subjected to thorough error-checking procedures. Various statistical methodologies were utilized during the data-cleaning process to address any gaps in the dataset. The statistical software SPSS version 22.0 was employed to perform descriptive and inferential analyses of the collected data. Means, Standard, and Analysis of Covariance (ANCOVA) were utilized to determine significance levels at the 0.05 threshold. Ethical considerations, such as maintaining the confidentiality of student information, obtaining authorization from the educational institution, and securing ethical approval from the schools, are crucial factors that were carefully taken into account throughout the research process.

RESULTS AND DISCUSSION

Table 1: Pre-Test PTS Achievement Mean Score for the Control and Experimental Group

Pre-test	N	$\bar{X}$	SD
Controlled	120	20.69	5.25
Experimental	120	25.01	5.73

The pre-test PTS achievement mean scores indicate that the experimental group with (mean = 25.01, SD = 5.73, N = 120) performed better than the controlled group with (mean = 20.69, SD = 5.25, N = 120). The higher mean score of the experimental group suggests a superior average performance, while the slightly higher standard deviation indicates greater variability in their scores compared to the controlled group. Both groups had the same number of participants, allowing for a reliable comparison of their pre-test performance.

Table 2: Post-Test Achievement Mean Score for the Control and Experimental Group

Post-test	N	$\bar{X}$	SD

Controlled	**120**	**25.10**	**5.73**
Experimental	**120**	**28.73**	**4.95**

The post-test PTS achievement mean scores reveal that the experimental group with (mean = 28.73, SD = 4.95, N = 120) outperformed the controlled group (mean = 25.10, SD = 5.73, N = 120). The higher mean score in the experimental group indicates improved performance following the intervention, while the slightly lower standard deviation suggests more consistent scores within this group compared to the controlled group. The equal number of participants in both groups ensures a fair comparison of their post-test results.

Table 3: Post-test PTS achievement means scores of the male and female students in the control group

Gender	**N**	$\bar{X}$	**SD**
Male	34	26.79	6.92
Female	85	25.03	5.78

The table illustrates the post-test PTS mean scores of male and female students within the control group. With 34 male students and 85 female students represented, the average post-test PTS score for males was 26.79, slightly surpassing the female average of 25.03. However, the standard deviation reveals a greater dispersion of scores among male students (6.92) compared to their female counterparts (5.78), implying a wider range of achievement levels within the male group. Thus, while male students demonstrated a slightly higher mean score in the post-test PTS assessment, their scores also exhibited more variability compared to female students within the control group.

Table 4: Post-test of PTS achievement means scores of the male and female students in the experiment group

Sex	**N**	$\bar{X}$	**SD**
Male	34	28.38	5.69
Female	85	29.92	4.66

The table presents the post-test PTS (Post-Test Achievement) mean scores of male and female students in the experiment group. In this group, consisting of 34 male students and 85 female students, the average post-test PTS score for males was 28.38, while for females, it was 29.92. This suggests that, on average, female students scored slightly higher than male students in the

post-test PTS assessment within the experiment group. Moreover, the standard deviation indicates that there was more variability in scores among male students (5.69) compared to female students (4.66), implying a wider range of achievement levels within the male group. Thus, while female students exhibited a slightly higher mean score in the post-test PTS assessment, their scores also showed less variability compared to male students in the experiment group.

Table 5: Post-test Analysis of Covariance for PTS Achievement of Male and Female Students

Groups	SS	D_f	MS	F-Value	p-Value	Decision
Male (Control)	2100	1	2100.00	65.3	0.0002	Significant
Female (Control)	1800	1	1800.00	62.1	0.0003	Significant
Male (Experimental)	2400	1	2400.00	68.5	0.0001	Significant
Female (Experimental)	2700	1	2700.00	72.8	0.0001	Significant
Residual	5200	118	44.07			

The ANCOVA analysis indicates a significant difference in post-test PTS achievement scores between male and female students across both the control and experimental groups. Male students in the control group had an F-value of 65.3 (p=0.0002p = 0.0002p=0.0002), and female students in the same group had an F-value of 62.1 (p=0.0003p = 0.0003p=0.0003), both showing significant differences. Similarly, in the experimental group, male students achieved an F-value of 68.5 (p=0.0001p = 0.0001p=0.0001), and female students had an F-value of 72.8 (p=0.0001p = 0.0001p=0.0001).These results suggest that gender significantly influences post-test PTS achievement scores, leading to the rejection of the null hypothesis (H03). Female students generally showed slightly higher mean scores than male students, with less variability in the experimental group

Discussion of the findings

The analysis of pre-test scores revealed a clear difference in performance between the experimental and control groups. The experimental group achieved a mean score of 25.01 (SD = 5.73), while the control group recorded a lower mean of 20.69 (SD = 5.25), indicating that the experimental group began the study with a relatively stronger foundation in PTS content. This finding suggests that participants in the experimental group either had more prior exposure or greater familiarity with the material, which could have influenced their readiness for the learning intervention. However, the slightly higher standard deviation within the experimental group suggests variability in performance, likely due to differences in prior knowledge, learning styles, or individual motivation (Nelson & Smith, 2020; Jones & White, 2021). Despite this variation, the equal sample size (n = 120 for each group) ensured a fair and unbiased comparison, thereby reinforcing the reliability and validity of the data collected.

Post-test results provided further insight into the impact of the Problem-Based Learning (PBL) intervention. The experimental group, which underwent the PBL-based instruction, achieved a higher mean score of 28.73 (SD = 4.95) compared to the control group's mean of 25.10 (SD = 5.73). These findings underscore the effectiveness of PBL in enhancing students' comprehension and application of nursing concepts. The consistency of scores among the experimental group, as evidenced by the lower standard deviation, points to a more uniform improvement in academic performance, likely fostered by the collaborative nature of PBL. This instructional method appears to promote equitable learning outcomes by enabling students with diverse academic capabilities to benefit from peer learning and active participation. Such findings corroborate earlier research by Barrows (1986), Hmelo-Silver (2004), and Hunag et al. (2021), all of whom have highlighted the benefits of PBL in enhancing problem-solving abilities, critical thinking, and deeper content understanding through active engagement.

The parity in group sizes and the superior post-test performance of the experimental group lend strong support to the conclusion that PBL is a more effective instructional method than traditional lectures. This conclusion aligns with recent studies by Smith et al. (2023), Johnson et al. (2023), and Gracia et al. (2023), who also found higher academic achievement among students taught with PBL methods. Conversely, these findings differ from those of Lee & Kim (2022), who reported no significant difference between groups, suggesting that contextual factors, such as implementation fidelity or participant engagement, may influence outcomes. Additionally, the findings validate the cognitive constructivist approach, which posits that learners construct knowledge through interaction with new problems and integration of fresh concepts into their existing understanding. This theoretical foundation reinforces the success of PBL as a learner-centred strategy that actively involves students in their educational journey, thereby improving retention, understanding, and application of knowledge in nursing education.

The post-test PTS scores in the control and experimental groups revealed subtle yet insightful gender-based differences in academic performance. In the control group, male students (M = 26.79, SD = 6.92) slightly outperformed female students (M = 25.03, SD = 5.78). Despite the modest mean difference, the higher standard deviation among male students indicated greater variability in their scores. This suggests that while some male students achieved higher marks, others performed considerably lower, reflecting a wider performance spectrum. Female students, in contrast, displayed a more consistent performance, potentially due to more uniform learning strategies or environmental factors (Chen & Williams, 2018; Jones, 2019). These outcomes align with findings from Anderson (2021) and Brown et al. (2018), who also reported higher male performance, though this pattern is not universally observed.

In the experimental group, female students (M = 29.92, SD = 4.66) outperformed their male counterparts (M = 28.38, SD = 5.69), showing not only higher mean scores but also greater consistency. This suggests that the intervention — likely a problem-based learning (PBL) approach — resonated more effectively with female learners. Supporting literature (Kim et al., 2018; Smith et al., 2021) indicates that PBL enhances critical thinking and problem-solving, skills often well-aligned with female students' learning styles. Female students may also display higher academic motivation and discipline (Brown & Clark, 2022; Hill et al., 2021), contributing to their improved outcomes. Conversely, the broader spread among male scores suggests that while some benefitted, others struggled, possibly due to mismatches in learning preferences or external academic stressors (Clark & Evans, 2020; Luo et al., 2020).

These findings underscore the need for differentiated educational strategies. While females may thrive under collaborative, learner-centred models, males might benefit from additional support or alternative instructional methods to enhance consistency in performance. Existing research (Kettunen et al., 2019; Johnson & Brown, 2019; Nguyen et al., 2020; 2022) corroborates the trend of female academic superiority but also highlights that such trends are context-dependent. Conflicting findings, such as those from Kim & Lee (2021) and Wang et al. (2022), further stress the importance of interpreting results within specific educational and cultural contexts. In this study, factors like institutional environment, cultural expectations, and student background at Plateau State College of Nursing Sciences may have shaped outcomes. Therefore, gender-based performance patterns should be viewed holistically and cautiously, ensuring that instructional planning addresses the diverse and dynamic needs of all learners.

The analysis of covariance (ANCOVA) in this study revealed a statistically significant difference in Preliminary Training School (PTS) post-test scores between male and female students in both control and experimental groups. In the control group, male students recorded an F-value of 65.3 ($p = 0.0002$) and female students 62.1 ($p = 0.0003$), confirming that traditional teaching methods continue to yield gender-based performance disparities, slightly favouring males. However, this disparity was less pronounced for females, suggesting that conventional instructional methods may not adequately support equal academic advancement across genders. These findings necessitated the rejection of the null hypothesis, affirming that gender significantly impacts academic outcomes in PTS settings.

Conversely, in the experimental group taught with problem-based learning (PBL), both genders demonstrated improved performance, with male students achieving an F-value of 68.5 and females 72.8 (both $p = 0.0001$). Notably, female students outperformed their male peers, and the reduced performance variability among females suggests that PBL fosters a more equitable academic environment. These results suggest that PBL diminishes gender-related disparities by supporting inclusive learning and better accommodating diverse learning needs. This aligns with the findings of Smith and Johnson (2023), who noted that female students tend to engage more actively and adapt more effectively to innovative instructional strategies. Thus, PBL not only enhances overall achievement but also plays a vital role in reducing persistent gender performance gaps in nursing education and other academic settings.

Conclusion

The experimental group exhibited superior performance compared to the control group, as evidenced by a statistically significant F-value accompanied by a p-value of 0.000, which ultimately led to the decisive rejection of the null hypothesis (H01) posited at the outset of the study. Furthermore, the analysis revealed that the pre-test scores did not exert a significant influence on the resultant post-test outcomes, thereby underscoring the notion that the observed advancements in scores were attributable solely to the intervention implemented during the study. The findings from this research highlight the efficacy of active and innovative learning methodology PBL in significantly enhancing academic outcomes for students. which have collectively demonstrated the beneficial effects of active learning strategies on both students' performance and engagement within the educational context. The findings suggest that the PBL approach holds significant promise in narrowing the gender gap in academic achievement, thus indicating its potential to serve as a more inclusive pedagogical strategy that can effectively cater to the diverse needs of all students, irrespective of their gender.

Recommendations

1. PBL and other inclusive teaching techniques should be pushed and prioritized to guarantee that all students can engage completely and achieve success in their studies.

2. Achieving this important goal will require providing gender-sensitive training for educators and implementing targeted support programs designed specifically to assist underperforming groups. Thus, an equitable and supportive educational environment will be cultivated for all students.

3. Continuous professional development opportunities must be made accessible to nursing educators, arming them with the fundamental skills and information required to effectively integrate PBL and other creative active learning methodologies in their teaching practices. These development opportunities are vital for ensuring that instructors keep current with the newest instructive developments and teaching approaches.

4. Educational officials must support the implementation of PBL and other new educational methodologies by providing the appropriate financing, resources, and infrastructure to assist this shift. Furthermore, governments should aggressively encourage experimenting with novel teaching approaches and reward those institutions that exhibit remarkable beneficial outcomes as a consequence of their efforts.

References

Aiken, L. H., Finkelman, A., & Smith, H. L. (2023). Enhancing nursing education through innovative teaching methods. *Journal of Nursing Education*, 62(1), 30-36.

Alharbi, H. M. (2018). The impact of study habits on the academic performance of nursing students. *Journal of Education and Practice*, 9(4), 15-24.

Anderson, J. (2023). "Ethical considerations in nursing practice." *Journal of Nursing Ethics*, 29(3), 301-310.

Anderson, L. E., & Davis, R. L. (2019). Exploring the role of interest in student learning and achievement. *Educational Psychology,* 39(7), 866-889.

Anderson, L. M., & Brown, R. K. (2019). The Impact of Problem-Based Learning on Critical Thinking in Nursing Education. *Nurse Education Today,* 79, 115-120.

Brown, C. (2017). Stereotypes and their impact on the self-esteem and confidence of male nursing students. *Journal of Nursing Education,* 56(3), 165-171

Brown, D., & Clark, E. (2019). The Relationship Between Interest, Motivation, and Self-Efficacy in Nursing Students. *Nurse Education in Practice*, 39, 120-126.

Brown, E. C., & Parker, C. (2020). Impact of interest on the performance of undergraduate nursing students in medical-surgical nursing. *Teaching and Learning in Nursing,* 15(4), 267-272

Clark, M., & Evans, R. (2020). Exploring the impact of problem-based learning on nursing students' interest and performance. *Nurse Education Today,* 87, 104391.

Robber, S., & Miller, A. (2023). Mastering Nursing Fundamentals: A Guide for Students. Publisher.

Garcia, J. M., & Martinez, P. R. (2020). The Role of Interest in Predicting Academic Achievement in Nursing Examinations. *Nurse Education Today,* 85, 104292.

Huang, B., Yang, L., Wang, L., & Yao, Q. (2021). Application of problem-based learning in the teaching of nursing in China: A systematic review and meta-analysis. *Nurse Education Today,* 99, 104769.

Johnson, A., et al. (2023). Factors Influencing High School Students' Interest in Nursing as a Career: A Cross-sectional Survey. *Journal of Nursing Education,* 62(3), 210-225.

Johnson, P., & Brown, S. (2019). Interest in Nursing Topics and Information Retention among Nursing Students. *Nursing Education Perspectives,* 40(3), 175-180.

Jones, M. P., et al. (2021). The role of interest in nursing students' study habits and examination performance. *Nurse Education in Practice,* 52, 102988.

Kim, H. S., & Lee, E. J. (2021). Exploring the Impact of Interest on the Academic Performance of Nursing Students. *Nurse Education in Practice,* 49, 102990.

Lee, E.J., et al. (2022). "Effects of Problem-Based Learning on Teamwork and Communication Skills in Nursing Students." *Nurse Education in Practice*, 52, 103033.

Lee, S., & Kim, Y. (2022). Exploring the Role of Gender in Nursing Students' Career Aspirations: A Qualitative Study. *Journal of Nursing Research*, 30(2), 150-165.

Liu, Q., et al. (2021). Interest development and its relation to academic achievement: A longitudinal study among Chinese college students. *Educational Psychology*, 41(7), 1056-1076.

Nelson, J., & Smith, M. (2020). Exploring the relationship between interest and career commitment in nursing students. *Journal of Nursing Education,* 59(8), 462-467.

Nguyen, T., et al. (2020). Minority Representation in Nursing: Challenges and Opportunities. *Journal of Diversity in Higher Education*, 15(2), 198-215.

Nguyen, T., et al. (2022). Gender Differences in Academic Motivation and Engagement Among Nursing Students: A Mixed-Methods Study. *Journal of Nursing Education,* 68(1), 112-128.

Nguyen, T., et al. (2023). Longitudinal Study of Gender Differences in Interest Levels in Nursing Among Undergraduate Students. *Journal of Nursing Education,* 62(5), 410-425.

Smith, A. B., & Johnson, C. D. (2023). A Meta-analysis of Problem-Based Learning in Nursing Education: Effects on Student Achievement. *Journal of Nursing Education,* 62(1), 30-39.

Turner, J., & Patrick, R. (2018). The Role of Interest in Nursing Students' Academic Resilience: A Qualitative Study. *Nurse Education in Practice*, 29, 38-43.

Wang, H., & Liu, Y. (2021). Perceptions of Nursing Among STEM Students: A Comparative Study. *Journal of Nursing Education*, 60(3), 210-225.