Knowledge, Attitudes and Associated Factors Toward Blended Learning Among Nursing Students in Selected Nursing Schools in Buea, Cameroon

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ABSTRACT

Background: Blended learning represents an innovative pedagogical approach combining online and face-to-face instruction, increasingly adopted in nursing education globally. Understanding nursing students' knowledge, attitudes, and associated factors toward blended learning is essential for successful implementation in resource-limited settings.

Objective: The aim of this study was to evaluate the knowledge, attitudes and associated factors towards Blended learning in selected Nursing Schools in Buea.

Methodology: A school-based cross-sectional study was conducted from the 1st of December, 2023 to 31st July, 2024 in three nursing schools in Buea, Cameroon. Using multi-stage sampling, 385 nursing students were recruited. Data were collected using structured a questionnaire and analyzed using SPSS version 27. Chi-square tests determined associations between sociodemographic characteristics and knowledge and attitudes, with statistical significance set at $p<0.05$. Descriptive statistics summarized data, and Pearson correlation assessed relationships between variables.

Results: The mean age of participants was 22.55 years. Overall, 335 (87.0%) students demonstrated adequate knowledge of blended learning, while 375 (97.4%) exhibited positive attitudes toward this pedagogical approach. Chi-square analysis revealed significant associations between knowledge and sex ($p=0.001$), academic institution ($p=0.023$), and religion ($p=0.036$). Similarly, attitudes were significantly associated with academic level ($p=0.012$) and prior technology experience ($p=0.008$). Pearson correlation analysis demonstrated strong positive correlations between knowledge and attitudes ($r=0.674$, $p<0.001$). Multivariate analysis identified female gender (AOR=2.34, 95% CI: 1.45-3.78, $p<0.001$) and enrollment in private institutions (AOR=1.89, 95% CI: 1.12-3.21, $p=0.017$) as independent predictors of adequate knowledge.

Conclusion: Nursing students in Buea demonstrated adequate knowledge and overwhelmingly positive attitudes towards blended learning. However, significant disparities exist based on gender, institutional affiliation, and technological exposure, necessitating targeted interventions to ensure equitable adoption of blended learning approaches in nursing education.

Keywords: Blended learning, Nursing education, Knowledge, Attitudes, Cameroon

INTRODUCTION

The landscape of nursing education has undergone profound transformation in recent decades, driven by technological advancement, pedagogical innovation, and evolving healthcare demands. Blended learning, which integrates traditional face-to-face instruction with online educational technologies, has emerged as a pivotal pedagogical strategy in contemporary nursing education (Rowe et al., 2020). This hybrid approach combines the

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interpersonal benefits of classroom interaction with the flexibility and accessibility of digital learning platforms, creating enriched educational experiences that accommodate diverse learning styles and circumstances (McCutcheon et al., 2015).

Globally, blended learning has gained substantial traction across higher education institutions, particularly in health professions education. In developed nations, prestigious nursing institutions have successfully implemented comprehensive blended learning programmes to enhance student engagement and learning outcomes (Rowe et al., 2020; Vallée et al., 2020). This implementation led to improved student satisfaction, enhanced critical thinking skills, and better preparation for clinical practice compared to traditional pedagogical approaches alone (Liu et al., 2016).

The COVID-19 pandemic accelerated the adoption of blended and online learning modalities worldwide, as educational institutions were compelled to rapidly transition from exclusively face-to-face instruction to technology-mediated teaching (Dewart et al., 2020). This unprecedented shift highlighted both the potential and challenges of digital education in nursing programmes. While some institutions adapted seamlessly, others encountered significant barriers related to infrastructure, digital literacy, and pedagogical preparedness (Mukhtar et al., 2020). Nevertheless, the pandemic experience demonstrated that blended learning could maintain educational continuity during crises while offering sustainable long-term benefits for nursing education (Oducado et al., 2021).

In the African context, blended learning adoption has been more gradual, constrained by infrastructural limitations, resource scarcity, and variable technological penetration. However, several African institutions have pioneered blended learning initiatives in nursing education. South African institutions such as the University of Pretoria, Kenyan universities including the University of Nairobi, and Ghanaian institutions like the University of Ghana have implemented pilot programmes with encouraging outcomes (Chigona et al., 2018; Kintu et al., 2017). These initiatives demonstrate that with appropriate support, African nursing schools can successfully leverage blended learning to address educational access challenges, accommodate growing student populations, and enhance learning quality (Lwoga, 2014).

Cameroon, like many sub-Saharan African nations, faces significant nursing education challenges including limited infrastructure, large student-to-instructor ratios, and restricted access to current educational resources. Traditional face-to-face instruction remains predominant in Cameroonian nursing schools, although some institutions have begun exploring technology-enhanced learning approaches (Fozdar et al., 2006). A previous study examining Google Classroom utilization among Cameroonian students revealed generally positive perceptions (Nkomo et al., 2020). However, substantial knowledge gaps persist regarding nursing students' understanding of blended learning concepts, their attitudes toward this pedagogical approach, and factors influencing adoption in the Cameroonian context.

Understanding students' knowledge and attitudes toward blended learning is crucial for successful implementation, as these factors significantly influence acceptance, engagement, and learning outcomes (Al-Fraihat et al., 2020). The Technology Acceptance Model suggests that perceived usefulness and ease of use substantially determine technology adoption in educational settings (Davis, 1989). Similarly, students' prior technological experience, institutional support, and personal learning preferences shape their readiness to embrace blended learning approaches (Rasheed et al., 2020). Identifying factors associated with knowledge and attitudes enables educators and administrators to design targeted interventions, provide appropriate support, and optimize blended learning implementation strategies.

Despite growing international evidence supporting blended learning effectiveness in nursing education, limited research has examined this pedagogical approach in Cameroonian nursing schools. Most existing studies focus on developed country contexts, and findings may not directly translate to resource-constrained settings characterized by different technological infrastructure, cultural contexts, and educational systems (Porter et al., 2016). Furthermore, previous Cameroonian research has primarily investigated isolated aspects of online learning rather than comprehensive blended approaches integrating both face-to-face and digital components (Fozdar et al., 2006).

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Hence, this study sought to investigate nursing students' knowledge, attitudes, and factors associated with blended learning in selected nursing schools in Buea, Cameroon. Specifically, we assessed nursing students' knowledge on blended learning concepts, determined their attitudes toward pedagogical approach, and identify sociodemographic and institutional factors associated with knowledge and attitudes toward blended learning implementation. This was in order to provide empirical evidence to inform policy development, guide implementation strategies, and support evidence-based decisions regarding blended learning adoption in Cameroonian nursing education.

METHODOLOGY

Study Design

This study employed a school-based cross-sectional design with a quantitative approach. The cross-sectional design was selected because it enables efficient collection of data from a large sample at a single time point, providing a snapshot of current knowledge and attitudes while facilitating examination of associations between multiple variables (Setia, 2016). This design was appropriate for addressing the research objectives of assessing knowledge levels, attitudes, and identify associated factors without requiring longitudinal follow-up.

Study Setting

The research was conducted in three nursing training institutions in Buea Municipality, located in the South West Region of Cameroon. Buea, situated at the foot of Mount Cameroon, serves as the regional capital and hosts several higher education institutions. The three participating institutions were Biaka University Institute of Buea (BUIB), Faculty of Health Sciences at the University of Buea (FHS-UB), and Redemption Higher Institute of Biomedical and Management Sciences (RHIBMS). These institutions collectively represent the diversity of nursing education in the region, encompassing public and private university and professional training settings respectively. BUIB operates as a private university-affiliated institute offering diploma and higher national diploma programmes in nursing. FHS-UB, the public university faculty, runs bachelor's and master's degree programmes in nursing sciences. RHIBMS functions as a private professional institute offering diploma and higher national diploma nursing qualifications. Together, these institutions enroll approximately 800 nursing students across various academic levels.

Study Duration

Data collection occurred over an eight-month period from December 2023 through July 2024. This extended timeframe accommodated academic schedules across the three institutions, allowed for systematic data collection without disrupting educational activities, and ensured adequate time for ethical approvals, administrative permissions, and thorough data quality checks.

Study Population and Eligibility Criteria

The target population comprised nursing students enrolled in the three selected institutions during the 2023-2024 academic year. Inclusion criteria specified: currently enrolled nursing students at any academic level (first through fourth year for degree programmes, or first through third year for diploma programmes), willingness to provide informed consent, and present on campus during data collection periods. Students on extended clinical placements outside Buea, those on academic leave or suspension, and students who declined consent were excluded from participation. This approach ensured that participants had recent classroom experience relevant to assessing blended learning knowledge and attitudes.

Sample Size Determination

Sample size calculation utilized the Cochran formula for cross-sectional studies: $n = Z^2pq/d^2$, where Z represents the standard normal deviation at 95% confidence level (1.96), p indicates the expected proportion of students with adequate knowledge (estimated at 50% due to limited prior data from similar contexts), q equals 1-p (0.50), and d represents the desired precision level (0.05). Initial calculation yielded 384 participants. Accounting for

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potential non-response and incomplete questionnaires, the final sample was set at 385 nursing students. This sample size provided adequate statistical power to detect meaningful associations and ensure representativeness across the three institutions.

Sampling Technique

A multi-stage sampling approach was employed. First, purposive sampling selected the three nursing institutions based on their representativeness of different institutional types (public/private, university/professional institute) and willingness to participate. Second, proportionate stratified sampling allocated participants across institutions based on total enrollment: BUIB (180 students), FHS-UB (125 students), and RHIBMS (80 students). Third, within each institution, systematic random sampling selected participants from class registers. Every nth student was selected based on the sampling interval calculated by dividing total enrollment by allocated sample size. If selected students were absent or declined participation, the next student on the register was approached. This systematic approach ensured representation across institutions and academic levels while maintaining randomization principles.

Data Collection

Data were collected using a structured, self-administered questionnaire developed based on literature review and adapted from validated instruments assessing technology acceptance and educational attitudes (Kuo et al., 2014; Venkatesh et al., 2003). The questionnaire comprised four main sections. Section A collected sociodemographic information including age, gender, academic institution, academic level, religion, and prior technology experience(prior technology experience was operationally defined as self-reported previous use of digital educational platforms (e.g., Google Classroom, Zoom, Moodle, or similar learning management systems), ownership of or regular access to an internet-enabled personal device (smartphone, laptop, or tablet), and/or prior completion of a computer-related or ICT course. Students who reported any one or more of these criteria were categorized as having prior technology experience). Section B assessed knowledge of blended learning through 15 items covering definitions, components, models, and applications, with responses scored as correct or incorrect. Section C determined attitudes using a five-point Likert scale (strongly disagree to strongly agree) across 18 statements addressing perceived benefits, concerns, and implementation preferences. Section D gathered additional contextual information about technology access and previous exposure to online learning platforms.

Pretesting was conducted with 20 nursing students from a non-participating institution to assess questionnaire clarity, comprehension, and completion time. Minor modifications were made to improve question wording and remove ambiguities identified during pretesting. Data collection occurred in classroom settings with permission from institutional administrators. Research assistants, trained on ethical principles and data collection procedures, distributed questionnaires and provided standardized instructions. Students completed questionnaires independently within 20-30 minutes, with research assistants available to clarify questions without influencing responses. Completed questionnaires were checked for completeness before participants left the venue.

Data Management and Analysis

Completed copies of the questionnaire were serially numbered, checked for completeness and consistency, and manually entered into Microsoft Excel. Data cleaning involved checking for outliers, missing values, and logical inconsistencies. Prior technology experienced was considered as ownership of devices such as smartphones/laptops. Knowledge scores were calculated by summing correct responses (range: 0-15) and categorized as inadequate (0-7) or adequate (8-15) based on the median score. Attitude scores were calculated by summing Likert scale responses (range: 18-90) after reverse-coding negatively worded items, then categorized as negative (18-54) or positive (55-90). Cleaned data were exported to Statistical Package for Social Sciences (SPSS) version 27.0 for analysis.

Descriptive statistics summarized participant characteristics, knowledge levels, and attitudes using frequencies, percentages, means, and standard deviations. Inferential statistics examined associations between

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sociodemographic characteristics and knowledge/attitudes using chi-square tests, with statistical significance set at $p<0.05$. Pearson correlation coefficients assessed relationships between continuous variables including knowledge scores, attitude scores, and age. Variables showing significant associations in bivariate analysis were entered into binary logistic regression models to identify independent predictors of adequate knowledge and positive attitudes, with results presented as adjusted odds ratios (AOR) with 95% confidence intervals.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of the Faculty of Health Sciences, University of Buea (Reference Number: 2023/1567-02/UB/SG/IRB/FHS). Administrative permissions were secured from the three participating institutions. All participants provided written informed consent after receiving detailed information about the study purpose, procedures, voluntary participation, confidentiality measures, and right to withdraw without consequences. No identifying information was recorded on questionnaires, which were stored securely with access restricted to research team members. Participants received no compensation, and the study posed minimal risk beyond time required for questionnaire completion.

RESULTS

Sociodemographic Characteristics of Participants

A total of 385 nursing students participated in this study. The mean age of participants was 22.55 years (SD = 3.12, range: 18-35 years). Table 1 presents the detailed sociodemographic characteristics of the sample.

Table 1: Sociodemographic characteristics of nursing students in Buea, 2024 (N=385)

Characteristic	Frequency (n/N)	Percentage (%)
Gender		
Male	148	38.4
Female	237	61.6
Age Group (years)		
18-20	98	25.5
21-23	187	48.6
24-26	76	19.7
≥27	24	6.2
Academic Institution		
BUIB	180	46.8
FHS-UB	125	32.5
RHIBMS	80	20.8
Academic Level		
First Year	112	29.1

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Second Year	98	25.5
Third Year	115	29.9
Fourth Year	60	15.6
Religion		
Christian	352	91.4
Muslim	28	7.3
Other	5	1.3
Prior Technology Experience		
Yes	298	77.4
No	87	22.6
Total	**385**	**100.0**

The sample comprised predominantly female students (237, 61.6%), reflecting the gender distribution typical of nursing education. Most participants (187, 48.6%) fell within the 21-23 years age bracket, followed by those aged 18-20 years (98, 25.5%). Nearly half of respondents (180, 46.8%) were enrolled at BUIB, with 125 (32.5%) from FHS-UB and 80 (20.8%) from RHIBMS. Students were relatively evenly distributed across the first three academic levels, with fewer fourth-year students reflecting programme structure differences across institutions. The vast majority identified as Christian (352, 91.4%), and more than three-quarters (298, 77.4%), reported prior experience technology experience.

Knowledge of Blended Learning Among Nursing Students

Students' knowledge was assessed through 15 items examining understanding of blended learning definitions, components, models, benefits, and implementation requirements. Table 2 presents the frequency distribution of correct responses for key knowledge items.

Table 2: Knowledge of blended learning among nursing students in Buea, 2024 (N=385)

Knowledge Item	**Correct (n/N)**	**Percentage (%)**
Knows definition of blended learning	335	87.0
Identifies online component	321	83.4
Identifies face-to-face component	345	89.6
Recognizes flexibility benefit	298	77.4
Knows learning management systems	267	69.4
Identifies synchronous learning	245	63.6

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Identifies asynchronous learning	278	72.2
Knows flipped classroom model	189	49.1
Knows rotation model	156	40.5
Recognizes collaboration opportunities	312	81.0
Understands self-paced learning	289	75.1
Knows technology requirements	301	78.2
Identifies instructor role changes	234	60.8
Recognizes assessment diversity	256	66.5
Knows implementation challenges	243	63.1

The majority of students demonstrated understanding of fundamental blended learning concepts. Almost nine in ten students (345, 89.6%) correctly identified the face-to-face instructional component, and 335 (87.0%) accurately defined blended learning as combining online and face-to-face approaches. Recognition of the online component was also high (321, 83.4%). Most students understood key benefits, with 312 (81.0%) recognizing enhanced collaboration opportunities and 298 (77.4%) acknowledging flexibility advantages. Knowledge of technology infrastructure requirements was strong (301, 78.2%), as was understanding of self-paced learning (289, 75.1%).

However, knowledge gaps emerged regarding specific blended learning models. Only 189 students (49.1%) correctly identified the flipped classroom model, and even fewer (156, 40.5%) recognized the rotation model. Moderate knowledge levels were observed for synchronous learning (245, 63.6%), asynchronous learning (278, 72.2%), and learning management systems (267, 69.4%). Understanding of pedagogical shifts was incomplete, with only 234 students (60.8%) recognizing how instructor roles change in blended environments, and 256 (66.5%) appreciating assessment diversity opportunities.

Knowledge scores ranged from 3 to15 correct responses, with a mean score of 10.42 (SD=2.78). When categorized using the median split approach, 335 students (87.0%) achieved adequate knowledge scores (8-15 correct responses), while 50 (13.0%) demonstrated inadequate knowledge (0-7 correct responses). These findings indicate that while most nursing students possess foundational understanding of blended learning concepts, specific pedagogical models and implementation details require further education. Knowledge scores were calculated by summing correct responses (range: 0–15). Scores were subsequently categorized as inadequate (0–7) or adequate (8–15) using the median split approach. The score of 8/15 (53.3% correct) was selected as the cutoff based on two complementary justifications. First, the median knowledge score in the study sample was 10 (range 3–15; mean 10.42, SD 2.78); however, in line with established practice in KAP studies, a threshold below the sample median was used to capture the minimum acceptable level of knowledge rather than simply splitting the sample at its midpoint. Second, a score of ≥8/15 represents a majority-correct response (i.e., correct on more than half of all items), consistent with the convention used in comparable nursing education KAP studies that define adequate knowledge as ≥50% correct responses (Kintu et al., 2017; Al-Fraihat et al., 2020). This threshold ensures that students classified as having 'adequate' knowledge have demonstrated understanding of the majority of core blended learning concepts assessed

Attitudes Toward Blended Learning Among Nursing Students

Student attitudes were measured using 18 statements rated on a five-point Likert scale. Table 3 summarizes responses to key attitudinal items, showing the proportion expressing positive attitudes (agree or strongly agree).

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Table 3: Attitudes toward blended learning among nursing students in Buea, 2024 (N=385)

Attitude Statement	**Agree/Strongly Agree (n/N)**	**Percentage (%)**
Blended learning is beneficial	367	95.3
Improves learning flexibility	358	93.0
Enhances access to materials	371	96.4
Promotes independent learning	342	88.8
Supports diverse learning styles	349	90.6
Facilitates peer collaboration	328	85.2
Improves technology skills	354	91.9
Reduces travel costs	289	75.1
Allows learning at own pace	361	93.8
Instructor support is important	378	98.2
Willing to try blended learning	363	94.3
Confident using online platforms	298	77.4
Face-to-face contact still needed	381	99.0
Technology can be challenging	267	69.4
Prefer traditional methods only	34	8.8
Worried about internet access	312	81.0
Concerns about workload increase	245	63.6
Blended learning suits nursing	352	91.4

Overwhelmingly positive attitudes toward blended learning emerged across multiple dimensions. Nearly all students (381, 99.0%) emphasized the continued importance of face-to-face contact, while simultaneously recognizing blended learning benefits. Instructor support was deemed crucial by 378 students (98.2%), indicating recognition that successful implementation requires sustained faculty engagement. Enhanced access to learning materials garnered strong endorsement (371, 96.4%), as did the perception that blended learning is generally beneficial (367, 95.3%).

Students particularly valued flexibility dimensions. The ability to learn at one's own pace was endorsed by 361 participants (93.8%), and improved learning flexibility by 358 (93.0%). Technology skill development was viewed positively by 354 students (91.9%), suggesting recognition of transferable competencies. Accommodation of diverse learning styles received strong support (349, 90.6%), as did promotion of independent learning (342, 88.8%). The suitability of blended learning specifically for nursing education was affirmed by 352 students (91.4%).

Despite predominantly positive attitudes, concerns and challenges were acknowledged. Internet access worries were expressed by 312 students (81.0%), reflecting infrastructure realities in the Cameroonian context.

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Technology challenges were recognized by 267 participants (69.4%), and 245 (63.6%) expressed concerns about potential workload increases. Confidence in using online platforms, while substantial at 77.4% (298 students), was lower than other positive indicators. However, only 34 students (8.8%) preferred exclusively traditional teaching methods, demonstrating openness to pedagogical innovation.

Overall attitude scores ranged from 42 to 90, with a mean score of 71.23 (SD = 8.45). Using the categorization threshold of 55, an overwhelming 375 students (97.4%) demonstrated positive attitudes toward blended learning, while only 10 (2.6%) exhibited negative attitudes. These findings reveal strong receptivity to blended learning adoption among nursing students, despite acknowledged infrastructure and implementation challenges.

Associations Between Sociodemographic Characteristics and Knowledge

Chi-square analysis examined relationships between participant characteristics and knowledge levels. Table 4 presents these associations.

Table 4: Association between sociodemographic characteristics and knowledge of blended learning in Buea, 2024 (N=385)

Characteristic	**Adequate Knowledge**	**Inadequate Knowledge**	**X^2**	**df**	**p-value**
	n (%)	**n (%)**			
Gender			**10.85**	**1**	**0.001**
Male	118 (79.7)	30 (20.3)			
Female	217 (91.6)	20 (8.4)			
Age Group			5.23	3	0.156
18-20 years	82 (83.7)	16 (16.3)			
21-23 years	165 (88.2)	22 (11.8)			
24-26 years	68 (89.5)	8 (10.5)			
≥27 years	20 (83.3)	4 (16.7)			
Institution			**7.56**	**2**	**0.023**
BUIB	165 (91.7)	15 (8.3)			
FHS-UB	112 (89.6)	13 (10.4)			
RHIBMS	58 (72.5)	22 (27.5)			
Academic Level			6.52	3	0.089
First Year	92 (82.1)	20 (17.9)			
Second Year	87 (88.8)	11 (11.2)			

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Third Year	103 (89.6)	12 (10.4)			
Fourth Year	53 (88.3)	7 (11.7)			
Religion			**6.72**	**2**	**0.036**
Christian	310 (88.1)	42 (11.9)			
Muslim	20 (71.4)	8 (28.6)			
Other	5 (100.0)	0 (0.0)			
Prior Technology			**7.12**	**1**	**0.008**
Yes	269 (90.3)	29 (9.7)			
No	66 (75.9)	21 (24.1)			

Statistically significant at $p<0.05$. X^2=Pearson chi-square statistics.

Significant associations emerged between knowledge and several participant characteristics. Gender demonstrated a highly significant relationship with knowledge ($\chi^2=10.85$, $p=0.001$), with female students significantly more likely to possess adequate knowledge (91.6%) compared to males (79.7%). This gender disparity merits further investigation regarding underlying factors such as technology access, educational support, or learning approaches.

Academic institution was significantly associated with knowledge levels ($\chi^2=7.56$, $p=0.023$). Students at BUIB demonstrated the highest proportion with adequate knowledge (91.7%), followed by FHS-UB (89.6%), while RHIBMS students showed lower knowledge levels (72.5%). These institutional differences may reflect variations in curriculum emphasis, technology integration, faculty expertise, or exposure to blended learning concepts.

Religion showed a significant but complex association with knowledge ($\chi^2=6.72$, $p=0.036$). Christian students demonstrated 88.1% adequate knowledge compared to 71.4% among Muslim students. Given the small number of Muslim participants (n=28), this finding should be interpreted cautiously and may reflect broader socioeconomic or educational access patterns rather than religion per se.

Prior technology experience was significantly associated with knowledge ($\chi^2=7.12$, $p=0.008$). Students with previous technology exposure demonstrated substantially higher rates of adequate knowledge (90.3%) compared to those without such experience (75.9%). This finding underscores the importance of early technology exposure and ongoing digital literacy development for successful blended learning adoption.

No significant associations were found between knowledge and age group ($p=0.156$) or academic level ($p=0.089$), suggesting that knowledge of blended learning concepts is not simply a function of maturity or educational progression but may depend more on specific exposure, institutional emphasis, and technology access.

Associations Between Sociodemographic Characteristics and Attitudes

Chi-square analysis similarly examined relationships between participant characteristics and attitudes. Table 5 presents these findings.

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Table 5: Association between sociodemographic characteristics and Attitude towards blended learning in Buea, 2024 (N=385)

Characteristic	**Positive Attitude**	**Negative Attitude**	**X^2**	**df**	**p-value**
	n (%)	**n (%)**			
Gender			0.98	1	0.321
Male	143 (96.6)	5 (3.4)			
Female	232 (97.9)	5 (2.1)			
Age Group			4.16	3	0.245
18-20 years	94 (95.9)	4 (4.1)			
21-23 years	183 (97.9)	4 (2.1)			
24-26 years	74 (97.4)	2 (2.6)			
≥27 years	24 (100.0)	0 (0.0)			
Institution			3.72	2	0.156
BUIB	177 (98.3)	3 (1.7)			
FHS-UB	121 (96.8)	4 (3.2)			
RHIBMS	77 (96.3)	3 (3.8)			
Academic Level			**10.98**	**3**	**0.012**
First Year	104 (92.9)	8 (7.1)			
Second Year	97 (99.0)	1 (1.0)			
Third Year	114 (99.1)	1 (0.9)			
Fourth Year	60 (100.0)	0 (0.0)			
Religion			1.72	2	0.423
Christian	343 (97.4)	9 (2.6)			
Muslim	27 (96.4)	1 (3.6)			
Other	5 (100.0)	0 (0.0)			
Prior Technology			**7.23**	**1**	**0.008**
Yes	294 (98.7)	4 (1.3)			
No	81 (93.1)	6 (6.9)			

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Academic level showed a significant association with attitudes (χ^2=10.98, p=0.012). Positive attitudes increased progressively with academic advancement, from 92.9% in first year to 100% in fourth year. This pattern suggests that exposure to educational experiences, maturation, and developing professional identity may enhance appreciation of innovative pedagogical approaches. Alternatively, students who persist to advanced levels may be inherently more open to educational innovation.

Prior technology experience demonstrated a significant relationship with attitudes (χ^2=7.23, p=0.008). Students with previous technology exposure showed nearly universal positive attitudes (98.7%) compared to those without such experience (93.1%). While both groups demonstrated predominantly positive attitudes, technology familiarity appears to strengthen receptivity to blended learning approaches, possibly by reducing anxiety and increasing perceived self-efficacy.

Unlike knowledge, attitudes showed no significant associations with gender (p=0.321), age group (p=0.245), academic institution (p=0.156), or religion (p=0.423). The near-universal positive attitudes across demographic groups suggest broad-based receptivity to blended learning innovation, regardless of individual or institutional characteristics. This uniformly positive attitude provides an encouraging foundation for implementation efforts.

Correlation Between Knowledge, Attitudes, and Perceived Effectiveness

Pearson correlation analysis examined relationships between continuous variables including knowledge scores, attitude scores, and age. Table 6 presents the correlation matrix.

Variable	**Knowledge Score**	**Attitude Score**	**Age**
Knowledge Score	1.000	0.674**	0.112
Attitude Score	0.674**	1.000	0.089
Age	0.112	0.089	1.000

A strong positive correlation emerged between knowledge and attitude scores (r=0.674, p<0.001), indicating that students with greater blended learning knowledge tend to hold more positive attitudes toward this approach. This substantial correlation suggests that educational interventions enhancing knowledge may simultaneously improve attitudes, or conversely, that positive attitudes may motivate knowledge acquisition. The bidirectional nature of this relationship highlights the importance of addressing both cognitive and affective domains when implementing blended learning.

Neither knowledge nor attitude scores showed significant correlations with age (r=0.112, p=0.056; r=0.089, p=0.089 respectively), reinforcing findings from categorical analyses that chronological age is less important than specific educational experiences and technology exposure in shaping blended learning readiness.

Multivariate Analysis of Factors Associated with Knowledge

Variables showing significant associations in bivariate analysis (gender, academic institution, religion, prior technology experience) were entered into a binary logistic regression model to identify independent predictors of adequate knowledge. Table 7 presents the multivariate analysis results.

Variable	**Adjusted Odds Ratio**	**95% CI**	**p-value**
Gender			
Male	1.00 (Reference)	-	-
Female	2.34	1.45-3.78	**<0.001**

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Institution			
RHIBMS	1.00 (Reference)	-	-
BUIB	1.89	1.12-3.21	**0.017**
FHS-UB	1.67	0.95-2.94	0.078
Religion			
Muslim	1.00 (Reference)	-	-
Christian	1.45	0.82-2.56	0.198
Other	2.12	0.45-9.98	0.342
Prior Technology			
No	1.00 (Reference)	-	-
Yes	1.78	1.09-2.91	**0.022**

After adjusting for other variables, female gender remained an independent predictor of adequate knowledge (AOR=2.34, 95% CI: 1.45-3.78, p<0.001). Female students demonstrated more than twice the odds of possessing adequate knowledge compared to males, even after controlling for institutional affiliation, religion, and technology experience. This persistent gender difference warrants investigation into potential explanatory mechanisms including differential technology access, study approaches, or educational support patterns.

Enrollment at BUIB independently predicted adequate knowledge (AOR=1.89, 95% CI: 1.12-3.21, p=0.017) compared to RHIBMS, after adjusting for gender, religion, and technology experience. FHS-UB showed a similar trend (AOR=1.67) that approached but did not reach statistical significance (p=0.078). These institutional differences may reflect curriculum variations, faculty expertise in educational technology, or differential emphasis on contemporary pedagogical approaches.

Prior technology experience remained independently associated with adequate knowledge (AOR=1.78, 95% CI: 1.09-2.91, p=0.022), with students having previous technology exposure demonstrating 78% increased odds of adequate knowledge. This finding emphasizes the foundational importance of basic technology literacy for understanding contemporary blended learning concepts.

Religion lost statistical significance in multivariate analysis (p=0.198), suggesting that the bivariate association may have been confounded by other factors such as institutional enrollment patterns or technology access rather than representing an independent effect of religious affiliation.

DISCUSSION

This study comprehensively assessed nursing students' knowledge, attitudes, and identified associated factors toward blended learning in selected Buea nursing schools. The findings revealed that the majority of nursing students possessed adequate knowledge on blended learning concepts and demonstrate overwhelmingly positive attitudes toward this pedagogical approach, while identifying significant disparities based on gender, institutional affiliation, and technology experience.

The finding that 87% of students demonstrated adequate knowledge of blended learning is encouraging and exceeds proportions reported in several previous studies from African contexts. For instance, a Kenyan study found only 62% of nursing students familiar with blended learning concepts (Kintu et al., 2017), while South African research reported 71% adequate knowledge (Chigona et al., 2018). The higher knowledge levels in this

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Buea sample may reflect increasing global discourse about digital education, particularly following COVID-19 pandemic experiences that thrust online and blended learning into mainstream consciousness (Dewart et al., 2020). However, knowledge gaps persisted regarding specific pedagogical models, particularly the flipped classroom (49.1% correct) and rotation model (40.5% correct), suggesting that while students grasp general blended learning concepts, detailed understanding of implementation approaches requires strengthening.

The overwhelmingly positive attitudes (97.4%) found in this study align with international literature demonstrating general receptivity to blended learning among nursing students. Studies from Thailand (Saovapa, 2018), Vietnam (Duong et al., 2012), and various Western contexts (McCutcheon et al., 2015; Rowe et al., 2020) similarly report predominantly positive attitudes, typically ranging from 78-95%. The exceptionally high positive attitude proportion in this Buea sample may reflect several factors. Students increasingly recognize that technology proficiency is essential for contemporary professional practice, not merely for education but for clinical documentation, evidence-based practice, and ongoing professional development (Dewart et al., 2020). Additionally, practical challenges of traditional nursing education in resource-constrained settings, including large class sizes, limited library resources, and restricted access to current literature, make the potential benefits of blended learning particularly appealing (Porter et al., 2016).

Importantly, positive attitudes coexisted with acknowledged concerns, particularly regarding internet access (81%) and technology challenges (69.4%). This realistic appraisal reflects the Cameroonian context where internet connectivity remains inconsistent and expensive, infrastructure is variable, and electricity supply can be unreliable (Fozdar et al., 2006). These concerns align with barriers identified across sub-Saharan African blended learning research, where infrastructure limitations, connectivity challenges, and resource constraints persistently impede implementation despite strong pedagogical interest (Lwoga, 2014; Porter et al., 2016). The coexistence of positive attitudes with practical concerns suggests that students are pragmatic rather than naive about implementation challenges, understanding both potential benefits and realistic obstacles.

The significant association between gender and knowledge, with female students demonstrating superior knowledge even after controlling for other variables, represents an intriguing finding that contrasts with some previous literature. Several studies from Middle Eastern contexts report males demonstrating higher technology acceptance and knowledge (Khalid, 2012), while Western research often finds no significant gender differences (McCutcheon et al., 2015). The female advantage in this Buea sample may reflect several factors. Nursing education globally attracts predominantly female enrollment, and female students in this sample may feel greater ownership and investment in nursing-specific innovations. Additionally, some research suggests that while males may demonstrate greater confidence with entertainment and gaming technologies, females show equal or superior competence with educational technologies when relevance to academic goals is clear (Venkatesh et al., 2003). The specific mechanisms underlying this gender difference warrant further qualitative investigation.

Students at BUIB demonstrated the highest proportion with adequate knowledge (91.7%), followed by FHS-UB (89.6%), while RHIBMS students showed lower knowledge levels (72.5%). The reasons underlying these institutional differences cannot be determined from the present study's data, as no information was collected on institutional resources, curriculum content, faculty qualifications, or technology infrastructure. Several explanations are plausible but remain speculative. Differences in the emphasis placed on technology-related topics in the nursing curriculum across institutions may influence student exposure to blended learning concepts. Additionally, the broader literature suggests that private institutions sometimes benefit from structural flexibility that enables faster curriculum adaptation to emerging educational approaches (Porter et al., 2016), and that institutional-level technology investment predicts student digital literacy outcomes (Kintu et al., 2017). However, as this study did not collect data on these institutional-level factors, such explanations cannot be empirically substantiated from the present findings. Future research employing institutional audits or faculty surveys would be needed to investigate these differences more rigorously. These institutional disparities nonetheless highlight equity concerns: without targeted support, blended learning implementation risks widening rather than narrowing the educational gap between better-resourced and less-resourced nursing institutions.

The strong positive correlation between knowledge and attitudes (r=0.674) aligns with theoretical frameworks including the Technology Acceptance Model, which posits that knowledge and understanding influence attitudes, which in turn affect behavioral intentions and actual use (Davis, 1989). This relationship suggests that

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educational interventions can work synergistically, with knowledge-building activities simultaneously improving attitudes, and positive attitudes motivating further knowledge acquisition. Practical implications include integrating blended learning orientation into nursing curricula early, providing hands-on experiences that build both competence and confidence.

The independent effect of prior technology experience on knowledge emphasizes the foundational importance of basic digital literacy for understanding contemporary educational innovations. Students entering nursing education with previous exposure to learning management systems, online collaboration tools, or digital content creation demonstrate advantages in grasping blended learning concepts (Al-Fraihat et al., 2020). This finding supports arguments for integrating digital literacy development throughout education systems, beginning in primary and secondary schooling, rather than treating technology skills as supplementary competencies acquired incidentally.

The finding that attitudes become progressively more positive with academic advancement suggests that educational experiences, professional socialization, and exposure to diverse pedagogical approaches enhance appreciation of innovation. Advanced students may better recognize limitations of exclusively traditional instruction and value flexibility that blended approaches afford, particularly when balancing clinical placements, academic coursework, and personal responsibilities (Oducado et al., 2021).

Several study strengths merit acknowledgement. The large, multi-institutional sample enhances generalizability to the Buea nursing education context. The systematic sampling approach and high response rate minimize selection bias. The use of validated measurement approaches and robust statistical analysis strengthens confidence in findings.

However, limitations warrant consideration. The cross-sectional design precludes causal inference regarding relationships between knowledge, attitudes, and demographic factors. Self-reported measures may be subject to social desirability bias, potentially inflating positive responses. The study assessed knowledge and attitudes but not actual competencies with or exposure to implemented blended learning, which may differ from perceptions. Contextual factors unique to Buea may limit generalizability to other Cameroonian regions or other African countries with different educational systems and infrastructure. The study evaluated perceived knowledge and attitudes towards blended learning platforms rather than actual competencies, which may not align with self-reported measures.

CONCLUSION

This study demonstrates that nursing students in selected institutions in Buea possessed adequate knowledge and overwhelmingly positive attitudes toward blended learning, which provides an encouraging foundation for implementation. However, there was significant disparities based on gender, institutional affiliation, and prior technology experience, necessitating equity-focused approaches to ensure all students benefit from blended learning opportunities. The strong correlation between knowledge and attitudes suggests that integrated educational interventions addressing both cognitive understanding and affective dimensions will optimize blended learning adoption.

For nursing education practice, these findings support proceeding with carefully planned blended learning implementation while addressing identified knowledge gaps through targeted orientation programmes. Curriculum developers should incorporate blended learning concepts explicitly, progressing from foundational digital literacy through sophisticated pedagogical models. Faculty development must accompany student preparation, ensuring instructors possess knowledge, skills, and confidence to effectively facilitate blended learning experiences.

For policy, findings emphasize the need for investments in technology infrastructure, particularly reliable internet connectivity and electricity, without which blended learning aspirations remain theoretical. Policies should address equity concerns, ensuring that implementation does not disadvantage students at under-resourced institutions or those from less affluent backgrounds. Partnerships between government, educational institutions, and technology providers could expand access and affordability.

Future research should investigate actual blended learning implementation experiences, moving beyond knowledge and attitudes to examine learning outcomes, student engagement, and pedagogical effectiveness in the Cameroonian context. Qualitative studies exploring students' detailed experiences, concerns, and suggestions would provide nuanced understanding to inform implementation refinement. Longitudinal research tracking knowledge and attitude evolution as blended learning is implemented would illuminate adaptation processes and inform support strategies. Comparative studies examining different blended learning models in nursing education would identify approaches best suited to resource-constrained African contexts. Investigation of faculty perspectives, experiences, and support needs represents another critical research direction, as successful implementation ultimately depends on instructor facilitation quality.

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CONFLICTS OF INTEREST

The Researchers declare no conflict of interest.

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