Perceived Effectiveness and Barriers Influencing Blended Learning Implementation in Nursing Education: A Mixed Methods Study in Buea, Cameroon

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ABSTRACT

Background: Despite growing recognition of blended learning benefits in nursing education, implementation in resource-constrained African contexts faces substantial barriers. Understanding perceived effectiveness and implementation challenges is essential for successful adoption in Cameroonian nursing schools.

Methods: A mixed-method study was conducted from December 2023 to July 2024 in three nursing institutions in Buea, Cameroon. The quantitative component recruited 385 nursing students and 90 instructors using multi-stage sampling, while the qualitative component involved purposive sampling of 12 class delegates. Structured questionnaires assessed perceived effectiveness and barriers, while semi-structured interviews explored implementation experiences. Data were analyzed using SPSS version 27 for quantitative analysis and thematic analysis for qualitative data. Chi-square tests determined associations between variables at $p<0.05$ significance.

Results: Among students, 373 (96.9%) perceived blended learning as effective for enhancing flexibility, 367 (95.3%) for improving access to learning materials, and 354 (91.9%) for developing technology skills. However, only 12(3.1%) perceived blended learning as effective for replacing face-to-face clinical instruction. Major barriers included internet connectivity issues (reported by 89.6% of students and 92.2% of instructors), electricity supply challenges (78.4% students, 85.6% instructors), inadequate technological resources (81.3% students, 88.9% instructors), insufficient technological literacy (63.6% students, 71.1% instructors), and instructor unwillingness to adopt new methods (52.7% students, 43.3% instructors). Qualitative findings revealed four major themes: infrastructure deficiencies, pedagogical concerns, resource limitations, and resistance to change. Chi-square analysis showed significant associations between perceived effectiveness and academic level ($p=0.018$), prior technology experience ($p=0.003$), and institutional affiliation ($p=0.029$).

Conclusion: While nursing students and instructors perceive blended learning as effective for enhancing flexibility and resource access, substantial barriers related to infrastructure, resources, and human capacity impede implementation. Successful blended learning adoption in Cameroonian nursing education requires comprehensive interventions addressing technological infrastructure, faculty development, resource provision, and institutional support systems.

Keywords: Blended learning, Perceived Effectiveness, Barriers, Nursing education, Cameroon

INTRODUCTION

The integration of technology into nursing education has become increasingly imperative in the twenty-first century, driven by rapid healthcare evolution, digital innovation, and recognition that contemporary nursing practice demands technological competence alongside traditional clinical skills (Rowe et al., 2020). Blended learning, which harmoniously combines face-to-face instruction with online educational technologies, has

emerged as a particularly promising pedagogical strategy for nursing education, offering potential to enhance learning flexibility, expand access to current resources, accommodate diverse learning preferences, and prepare students for technology-integrated healthcare environments (McCutcheon et al., 2015). However, successful implementation requires not merely theoretical endorsement but practical understanding of how stakeholders perceive effectiveness and what barriers impede adoption in specific contexts.

Internationally, substantial evidence documents blended learning effectiveness in nursing education. Systematic reviews and meta-analyses consistently demonstrate that well-designed blended learning approaches produce learning outcomes equivalent to or superior to traditional face-to-face instruction alone, while offering additional benefits including enhanced student engagement, improved critical thinking, greater learning flexibility, and increased technology proficiency (Liu et al., 2016; Vallée et al., 2020). Studies from diverse international contexts, including the United States, United Kingdom, Australia, Thailand, and Vietnam, report positive student perceptions of blended learning effectiveness, with learners particularly valuing flexibility, accessibility, self-paced learning opportunities, and multimedia resource availability (McCutcheon et al., 2015; Saovapa, 2018; Duong et al., 2012).

However, implementation effectiveness depends substantially on contextual factors including technological infrastructure, institutional support, faculty competence, student preparedness, and resource availability (Rasheed et al., 2020). What proves effective in well-resourced Western universities with robust infrastructure, experienced faculty, and technologically proficient students may encounter significant obstacles in resource-constrained African settings characterized by unreliable electricity, expensive limited-bandwidth internet, insufficient computers, and variable digital literacy (Porter et al., 2016). Understanding effectiveness perceptions within specific implementation contexts is therefore essential for realistic planning and appropriate adaptation.

Simultaneously, extensive literature documents barriers impeding blended learning implementation, particularly in developing country contexts. Infrastructure challenges, including unreliable internet connectivity, insufficient bandwidth, frequent electricity outages, and limited computer access, consistently emerge as primary obstacles across African educational research (Lwoga, 2014; Mtebe & Raisamo, 2014). Human capacity barriers, including inadequate digital literacy among students and faculty, insufficient pedagogical training for technology-enhanced instruction, and faculty resistance rooted in comfort with traditional methods, represent another major impediment category (Rasheed et al., 2020; Porter et al., 2016). Institutional barriers, encompassing inadequate financial investment, absent technology policies, insufficient technical support, and rigid curricula resistant to innovation, further constrain implementation (Antwi et al., 2021; Khalid, 2012). Understanding these barriers comprehensively and prioritizing interventions appropriately is essential for overcoming implementation obstacles.

The COVID-19 pandemic thrust online and blended learning into unprecedented prominence as educational institutions worldwide abruptly transitioned from face-to-face to remote instruction (Dewart et al., 2020). This emergency transition provided valuable insights into both the potential and limitations of technology-mediated education in diverse contexts. While some institutions adapted relatively smoothly, others encountered profound challenges exposing infrastructure inadequacies, pedagogical unpreparedness, and digital divides (Mukhtar et al., 2020). Post-pandemic discourse increasingly recognizes that sustainable, effective blended learning implementation requires deliberate planning, substantial investment, comprehensive training, and contextually appropriate approaches rather than hasty technology adoption (Oducado et al., 2021).

In sub-Saharan Africa, blended learning research remains limited compared to Western contexts, with existing studies primarily concentrated in South Africa, Kenya, Ghana, and Tanzania (Lwoga, 2014; Kintu et al., 2017; Antwi et al., 2021). Cameroonian research specifically examining blended learning in nursing education is particularly scarce. Previous Cameroonian educational technology studies have investigated specific platforms such as Google Classroom, revealing generally positive student perceptions but also documenting persistent challenges related to connectivity, costs, and digital literacy (Nkomo et al., 2020). However, comprehensive mixed-methods investigation of perceived effectiveness and implementation barriers specifically within Cameroonian nursing education contexts remains absent, representing a significant knowledge gap given nursing education's unique requirement including clinical skill development, professional socialization, and integration of theoretical and practical learning.

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Understanding stakeholder perceptions of blended learning effectiveness is crucial because these perceptions substantially influence adoption decisions, implementation quality, sustained engagement, and ultimately learning outcomes (Al-Fraihat et al., 2020). If students perceive blended approaches as ineffective or inferior to traditional instruction, engagement suffers regardless of objective pedagogical quality. Similarly, if instructors perceive blended learning as pedagogically problematic or professionally threatening, implementation will be superficial and ineffective despite institutional mandates. Conversely, positive effectiveness perceptions, grounded in genuine experience rather than naive optimism, create foundation for sustained commitment and continuous improvement.

Comprehensive barrier identification is equally essential because implementation success depends on systematically addressing obstacles rather than assuming that technology availability alone ensures effective adoption (Rasheed et al., 2020). Barriers operate at multiple levels, individual (student and instructor characteristics, attitudes, skills), institutional (policies, resources, support systems), and societal (infrastructure, culture, economics), and effective interventions must address relevant levels rather than focusing narrowly on single factors. Mixed-methods investigation, combining quantitative barrier prevalence measurement with qualitative exploration of stakeholder experiences, provides particularly rich understanding appropriate for informing comprehensive intervention strategies (Creswell & Plano Clark, 2017).

This study addresses identified knowledge gaps by comprehensively investigating perceived effectiveness and barriers influencing blended learning implementation in selected nursing schools in Buea, Cameroon, using a mixed-methods approach. Specifically, the research aimed to determine nursing students' and instructors' perceived effectiveness of blended learning for nursing education, identify barriers to blended learning implementation from multiple stakeholder perspectives, explore stakeholder experiences and perspectives regarding blended learning through qualitative inquiry, and examine associations between perceived effectiveness, barriers, and participant characteristics. The findings provide evidence-based foundation for planning contextually appropriate blended learning implementation in Cameroonian nursing education and similar resource-constrained settings.

METHODOLOGY

Study Design

This research employed a mixed-methods design, specifically a convergent parallel design, wherein quantitative and qualitative data were collected simultaneously, analyzed separately, and then integrated during interpretation (Creswell & Plano Clark, 2017). The quantitative component utilized a cross-sectional survey design to measure perceived effectiveness and identify barriers among nursing students and instructors. The qualitative component employed semi-structured interviews with class delegates to explore implementation experiences and perspectives in depth. This mixed-methods approach was selected because it provides comprehensive understanding that neither quantitative nor qualitative methods alone could achieve, with quantitative data establishing prevalence and associations while qualitative data illuminating underlying meanings, contexts, and experiences (Creswell & Plano Clark, 2017). At the time of the study, none of the participating institutions had fully implemented blended learning; perceptions were based on limited pilot experiences and understanding of the concept rather than comprehensive implementation experience.

Study Setting

The study was conducted in three nursing institutions in Buea Municipality, South West Region of Cameroon. These institutions were Biaka University Institute of Buea (BUIB), a private university-affiliated institute offering diploma and higher national diploma nursing programmes; Faculty of Health Sciences at the University of Buea (FHS-UB), the public university faculty providing bachelor's and master's degree nursing programmes; and Redemption Higher Institute of Biomedical and Management Sciences (RHIBMS), a private professional institute offering diploma and higher national diploma nursing qualifications. Together, these institutions enroll approximately 800 nursing students and employ approximately 120 nursing instructors, representing diverse institutional types and serving varied student populations within the Buea educational ecosystem.

Study Duration

The research was conducted over eight months from December 2023 through July 2024. This extended timeframe accommodated ethical approval processes, administrative permissions from multiple institutions, pilot testing, systematic data collection across academic calendars, interview scheduling with busy class delegates, and thorough data analysis and validation procedures.

Study Population

The study involved three distinct populations. The quantitative student sample comprised nursing students enrolled at any academic level in the three participating institutions during the 2023-2024 academic year. The quantitative instructor sample included nursing instructors and administrators teaching in the three institutions. The qualitative sample consisted of class delegates, student leaders selected by peers to represent their classes in administrative and academic matters, chosen because their leadership positions provided broader perspective on class experiences and challenges.

Eligibility Criteria

For student participants, inclusion criteria specified currently enrolled nursing students at any academic level, willingness to provide informed consent, and presence on campus during data collection. Students on extended clinical placements outside Buea, those on academic leave or suspension, and students declining consent were excluded. For instructor participants, inclusion criteria required active teaching in participating institutions, involvement in nursing programme delivery, and consent provision. Instructors on leave, those teaching exclusively non-nursing courses, and those declining consent were excluded. For class delegate participants, inclusion criteria specified current status as elected or appointed class representative, willingness to participate in audio-recorded interviews, and informed consent provision.

Sample Size and Sampling

For the quantitative student component, sample size calculation utilized the formula $n = Z^2pq/d^2$, with $Z=1.96$ (95% confidence), $p=0.50$ (conservative estimate), and $d=0.05$ (precision), yielding $n=384$, rounded to 385 to account for potential non-response. Students were sampled using multi-stage sampling. First, the three institutions were purposively selected to represent diverse institutional types. Second, proportionate stratified sampling allocated participants across institutions based on enrollment: BUIB (180 students), FHS-UB (125 students), RHIBMS (80 students). Third, systematic random sampling selected individual participants from class registers within each institution.

For the quantitative instructor component, all 90 instructors teaching nursing courses across the three institutions during the study period were invited to participate, representing census sampling rather than probability sampling due to the relatively small instructor population. This approach ensured maximum representation of instructor perspectives.

For the qualitative component, purposive sampling selected 12 class delegates (4 from each institution) representing different academic levels and programmes. Purposive sampling was appropriate because class delegates, by virtue of their leadership positions, possess informed perspectives on class experiences, challenges, and needs, making them key informants for exploring implementation barriers and effectiveness perceptions (Palinkas et al., 2015).

Data Collection Instruments and Procedures

Three instruments were employed. For students, a structured self-administered questionnaire comprised four sections: sociodemographic characteristics, perceived effectiveness items using five-point Likert scales, barrier identification items, and prior technology experience. The perceived effectiveness section included 18 items assessing dimensions including learning flexibility, resource access, skill development, clinical application, engagement, and satisfaction. The barriers section listed 15 potential barriers, asking students to indicate whether each represented a challenge they perceived or experienced.

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For instructors, a parallel structured questionnaire included sections on demographic information, teaching experience, perceived effectiveness of blended learning for nursing education delivery, barriers encountered or anticipated, and willingness to adopt blended approaches. This instrument was adapted from validated technology acceptance and educational innovation surveys (Venkatesh et al., 2003; Kuo et al., 2014).

For class delegates, a semi-structured interview guide explored topics including understanding of blended learning, experiences with technology-enhanced instruction, perceptions of effectiveness for nursing education, specific barriers encountered or observed, suggestions for successful implementation, and concerns about blended learning adoption. The guide used open-ended questions encouraging detailed responses and follow-up probes for clarification and elaboration.

Pretesting was conducted with 20 students and 5 instructors from a non-participating institution, and 3 class delegates from the same non-participating institution, to assess instrument clarity, comprehension, cultural appropriateness, and completion time. Minor modifications improved question wording and cultural relevance.

Quantitative data collection occurred in classroom settings with institutional permission. Research assistants distributed questionnaires to students during class breaks, providing standardized instructions emphasizing voluntary participation and confidentiality. Students completed questionnaires independently within 20-30 minutes. Instructor questionnaires were delivered to faculty offices with collection scheduled after one week, allowing completion at instructors' convenience.

Qualitative data collection involved individual face-to-face interviews conducted in private settings on institutional premises. Interviews, lasting 30-50 minutes, were audio-recorded with participant permission. The interviewer followed the semi-structured guide while remaining flexible to explore emerging themes. Field notes documented non-verbal communication and contextual observations.

Data Management and Analysis

Quantitative data from completed questionnaires were checked for completeness, serially numbered, manually entered into Microsoft Excel, and cleaned by checking for outliers, missing values, and logical inconsistencies. Perceived effectiveness scores were calculated by summing Likert scale responses across items (range: 18-90) and categorized as ineffective (18-54) or effective (55-90). Individual effectiveness items were analyzed separately to identify specific dimensions perceived as effective or ineffective. Barrier prevalence was calculated as percentages of students and instructors endorsing each barrier. Cleaned data were imported into Statistical Package for Social Sciences (SPSS) version 27.0 for analysis.

Descriptive statistics summarized participant characteristics, perceived effectiveness levels, and barrier prevalence using frequencies, percentages, means, and standard deviations. Chi-square tests examined associations between perceived effectiveness and participant characteristics including gender, age, academic level, institution, and prior technology experience, with statistical significance set at $p<0.05$.

Qualitative data analysis followed thematic analysis procedures (Braun & Clarke, 2006). Audio recordings were transcribed verbatim, and transcripts were read repeatedly for familiarization. Initial codes were generated systematically across the entire dataset, capturing interesting features relevant to research questions. Codes were collated into potential themes by grouping similar codes. Themes were reviewed against coded extracts and the entire dataset to ensure coherence and distinctiveness. Themes were defined and named, with detailed analysis of each theme's essence and contribution to overall understanding. Selected quotations illustrating each theme were extracted for presentation. Two researchers independently coded a subset of transcripts, with discrepancies resolved through discussion to enhance reliability.

Integration of quantitative and qualitative findings occurred during interpretation, with qualitative themes providing contextual depth and explanatory insight for quantitative patterns, and quantitative prevalence data indicating how widely qualitative themes applied across the sample (Creswell & Plano Clark, 2017).

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 participating institutions. All participants provided written informed consent after receiving comprehensive information about study purpose, procedures, voluntary participation, confidentiality protections, absence of direct benefits or compensation, minimal risks, and right to withdraw without penalty. Interview participants additionally consented to audio recording. No personally identifying information was recorded on questionnaires or linked to interview recordings. Data were stored securely with access restricted to research team members. Participants received no compensation beyond appreciation for their time.

RESULTS

Participant Characteristics

Quantitative Sample: Nursing Students

The quantitative component recruited 385 nursing students (100.0% response rate) with mean age of 22.55 years (SD=3.12, range: 18-35 years). Table 1 summarizes student characteristics. The sample comprised 237 females (61.6%) and 148 males (38.4%). Most students (187, 48.6%) were aged 21-23 years. Institutional distribution included 180 students (46.8%) from BUIB, 125 (32.5%) from FHS-UB, and 80 (20.8%) from RHIBMS. Academic level distribution showed 112 first-year students (29.1%), 98 second-year (25.5%), 115 third-year (29.9%), and 60 fourth-year (15.6%). The majority (352, 91.4%) identified as Christian. Most students (298, 77.4%) reported prior experience with educational technology platforms such as Google Classroom, Zoom, or learning management systems.

Table 1: Characteristics of nursing student participants (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
Second Year	98	25.5
Third Year	115	29.9
Fourth Year	60	15.6
Prior Technology Experience		
Yes	298	77.4
No	87	22.6
Total	**385**	**100.0**

Quantitative Sample: Nursing Instructors

Among the 90 instructors invited, 85 completed questionnaires (94.4% response rate). Table 2 presents instructor characteristics. The instructor sample included 52 males (61.2%) and 33 females (38.8%). Most instructors (38, 44.7%) were aged 35-44 years. Institutional distribution showed 41 instructors (48.2%) from BUIB, 28 (32.9%) from FHS-UB, and 16 (18.8%) from RHIBMS. Teaching experience varied: 23 instructors (27.1%) had less than 5 years' experience, 31 (36.5%) had 5-10 years, 22 (25.9%) had 11-15 years, and 9 (10.6%) had more than 15 years. Most instructors (68, 80.0%) had received no formal training in blended learning pedagogy.

Table 2: Characteristics of nursing instructor participants (N=85)

Characteristic	Frequency (n/N)	Percentage (%)
Gender		
Male	52	61.2
Female	33	38.8
Age Group (years)		
25-34	18	21.2
35-44	38	44.7
45-54	22	25.9
≥55	7	8.2
Academic Institution		
BUIB	41	48.2
FHS-UB	28	32.9
RHIBMS	16	18.8
Teaching Experience (years)		
<5	23	27.1
5-10	31	36.5
11-15	22	25.9
>15	9	10.6
Blended Learning Training		
Yes	17	20.0
No	68	80.0
Total	**85**	**100.0**

Qualitative Sample: Class Delegates

Twelve class delegates participated in qualitative interviews, with 8 males (66.7%) and 4 females (33.3%). Ages ranged from 20 to 28 years (mean=23.2 years). Four delegates represented each institution (BUIB, FHS-UB, RHIBMS), with representation across first through fourth academic years. All delegates had been in leadership positions for at least one semester, providing adequate time to develop informed perspectives on class experiences.

Perceived Effectiveness of Blended Learning

Student Perceptions of Effectiveness

Students rated blended learning effectiveness across 18 dimensions using five-point Likert scales. Table 3 presents the proportion of students perceiving each dimension as effective (agree or strongly agree).

Table 3: Student perceptions of blended learning effectiveness (N=385)

Effectiveness Dimension	Effective (n/N)	Percentage (%)
Enhances learning flexibility	373	96.9
Improves access to learning materials	367	95.3
Allows learning at own pace	361	93.8
Develops technology skills	354	91.9
Supports diverse learning styles	349	90.6
Promotes independent learning	342	88.8
Facilitates peer collaboration	328	85.2
Provides multimedia learning resources	345	89.6
Enables convenient content review	358	93.0
Reduces transportation costs	289	75.1
Increases engagement	312	81.0
Improves learning outcomes	298	77.4
Prepares for digital healthcare	336	87.3
Effective for theoretical content	352	91.4
Effective for clinical skills	98	25.5
Replaces face-to-face instruction	12	3.1
Suitable for nursing education	352	91.4
Improves exam performance	245	63.6

Students perceived blended learning as highly effective across multiple dimensions. Nearly all students (373, 96.9%) agreed that blended learning enhances learning flexibility, a fundamental advantage in resource-constrained contexts where students may balance academic demands with work, family responsibilities, or challenging commutes. Similarly, 367 students (95.3%) perceived blended learning as effective for improving access to learning materials, addressing persistent challenges in Cameroonian nursing education where library resources are limited, textbooks are expensive, and access to current literature is restricted.

The ability to learn at one's own pace was valued by 361 students (93.8%), reflecting appreciation for personalized learning opportunities rarely available in large traditional classes. Technology skill development was perceived as an important benefit by 354 students (91.9%), demonstrating recognition that digital competence is increasingly essential for contemporary nursing practice, not merely for educational purposes. Accommodation of diverse learning styles (349 students, 90.6%) and promotion of independent learning (342 students, 88.8%) represented additional valued effectiveness dimensions.

Students perceived blended learning as particularly effective for theoretical content delivery, with 352 students (91.4%) endorsing this dimension. However, effectiveness for clinical skills instruction received substantially lower endorsement, with only 98 students (25.5%) perceiving blended learning as effective for this purpose. This distinction reflects appropriate recognition that hands-on clinical skills such as wound care, catheterization, medication administration, and patient assessment require supervised physical practice that technology cannot fully replace, although virtual simulations can provide valuable supplementary experiences.

Importantly, students overwhelmingly rejected the notion that blended learning should replace face-to-face instruction, with only 12 students (3.1%) perceiving blended approaches as effective replacements. This finding demonstrates realistic understanding that blended learning represents a complementary enhancement rather than a wholesale substitution for traditional pedagogical approaches, particularly important in nursing education where interpersonal interaction, professional socialization, and supervised clinical practice remain irreplaceable.

Overall effectiveness scores ranged from 38 to 90, with a mean of 72.18 (SD=9.34). Using the categorization threshold of 55, a total of 373 students (96.9%) perceived blended learning as effective overall, while 12 students (3.1%) perceived it as ineffective. These findings demonstrate strong belief in blended learning potential among Cameroonian nursing students, providing encouraging foundation for implementation efforts.

Instructor Perceptions of Effectiveness

Instructors similarly rated blended learning effectiveness across parallel dimensions.

Table 4 presents instructor effectiveness perceptions.

Table 4: Instructor's effectiveness perceptions (N=85)

Effectiveness Dimension	Effective (n/N)	Percentage (%)
Enhances teaching flexibility	78	91.8
Expands access to resources	81	95.3
Accommodates large classes	72	84.7
Develops student independence	69	81.2
Facilitates content updates	76	89.4
Enables diverse assessment	71	83.5
Tracks student progress	68	80.0
Reduces repetitive lecturing	65	76.5
Effective for theory teaching	79	92.9
Effective for clinical teaching	23	27.1
Suitable for nursing education	74	87.1
Improves learning outcomes	61	71.8
Requires excessive preparation time	67	78.8
Increases teaching workload	73	85.9

Instructors' effectiveness perceptions largely aligned with students' perspectives while adding pedagogical nuances. Most instructors (81, 95.3%) perceived blended learning as effective for expanding access to teaching and learning resources, a particular advantage given that many instructors struggle to provide comprehensive, current materials through traditional approaches. Teaching flexibility was valued by 78 instructors (91.8%), reflecting recognition that blended approaches can reduce constraints imposed by fixed class schedules and limited classroom availability.

Instructors particularly valued blended learning for facilitating content updates (76, 89.4%), a significant advantage in rapidly evolving fields like nursing where evidence-based practices, clinical guidelines, and technological applications change frequently. Traditional printed materials quickly become outdated, whereas digital resources can be updated continuously. The ability to accommodate large classes through blended approaches was recognized by 72 instructors (84.7%), addressing a persistent challenge in Cameroonian nursing education where student enrollment often exceeds classroom capacity and instructor availability.

Like students, instructors demonstrated clear distinction between theoretical and clinical content, with 79 instructors (92.9%) perceiving blended learning as effective for theory teaching but only 23 (27.1%) endorsing effectiveness for clinical teaching. This professional consensus that clinical skills require hands-on supervised practice provides important guidance for implementation planning, suggesting that blended approaches should focus primarily on theoretical content, clinical reasoning, and case-based learning rather than attempting to replace clinical skills laboratories or supervised patient care experiences.

Importantly, instructors acknowledged workload concerns, with 73 (85.9%) agreeing that blended learning increases teaching workload, at least initially, and 67 (78.8%) noting that it requires excessive preparation time. These perceptions reflect realistic understanding that developing quality online materials, learning new technologies, redesigning courses for blended delivery, and managing both online and face-to-face components demands substantial time investment. These workload concerns represent important barriers that implementation strategies must address through adequate preparation time, technical support, and workload recognition.

Overall, 78 instructors (91.8%) perceived blended learning as effective when assessed holistically, compared to 7 (8.2%) perceiving it as ineffective. This strong instructor support provides essential foundation for implementation success, as instructor buy-in substantially influences implementation quality and sustainability.

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Barriers to Blended Learning Implementation

Barriers Reported by Students

Students indicated which of 15 potential barriers they perceived as challenges to blended learning implementation. Table 5 presents barrier prevalence among students.

Table 5: Barrier prevalence among students (n=385)

Barrier	Frequency (n)	Percentage (%)
Poor internet connectivity	345	89.6
High internet costs	334	86.8
Unreliable electricity supply	302	78.4
Insufficient computers/devices	313	81.3
Lack of technical support	289	75.1
Insufficient digital literacy	245	63.6
Instructor unwillingness	203	52.7
Lack of blended learning training	267	69.4
Preference for traditional methods	189	49.1
Inadequate learning management systems	278	72.2
Limited institutional support	256	66.5
Social distractions at home	234	60.8
Limited interaction with instructors	221	57.4
Difficulty understanding online content	198	51.4
Time management challenges	243	63.1

Infrastructure barriers emerged as most prevalent. Poor internet connectivity was identified by 345 students (89.6%) as a significant implementation barrier, reflecting persistent challenges in Cameroonian contexts where internet coverage is inconsistent, bandwidth is limited, and reliability varies substantially by location and time. High internet costs were noted by 334 students (86.8%), a particularly significant barrier for students from lower-income backgrounds for whom data costs represent substantial financial burden. Unreliable electricity supply, reported by 302 students (78.4%), represents another fundamental infrastructure challenge in Cameroon where power outages are frequent and extended, rendering online learning impossible during blackout periods and limiting ability to charge devices.

Technological resource barriers were also highly prevalent. Insufficient access to computers or appropriate devices was reported by 313 students (81.3%), reflecting socioeconomic disparities where not all students own personal computers and smartphones may provide inadequate platforms for serious academic work. Inadequate learning management systems were identified by 278 students (72.2%), suggesting that existing institutional technology platforms are limited, difficult to use, or insufficiently robust for comprehensive blended learning delivery.

Human capacity barriers represented another major category. Lack of training in blended learning approaches was reported by 267 students (69.4%), indicating that students feel unprepared to learn effectively in blended environments despite general technology familiarity. Insufficient digital literacy was acknowledged by 245 students (63.6%), revealing gaps between basic social media use and academic technology competencies required for effective blended learning participation. Time management challenges were noted by 243 students (63.1%), reflecting that the flexibility of blended learning, while advantageous, also demands self-regulation skills that some students find challenging.

Social and pedagogical barriers included distractions at home (234 students, 60.8%), limited interaction with instructors in online components (221 students, 57.4%), and difficulty understanding content delivered online (198 students, 51.4%). Instructor unwillingness to adopt blended methods was perceived by 203 students (52.7%), suggesting that some faculty resistance or reluctance influences student experiences and expectations.

Preference for traditional methods was reported by 189 students (49.1%), indicating that nearly half of students experience some comfort with familiar approaches and uncertainty about change.

Barriers Reported by Instructors

Instructors reported parallel barrier prevalence. Table 6 presents instructor-identified barriers.

Table 6: Barriers to blended learning implementation as reported by instructors (n=85)

Barrier	Frequency (n)	Percentage (%)
Poor internet connectivity	78	91.8
Unreliable electricity supply	73	85.9
Insufficient institutional computers	76	89.4
Inadequate learning management systems	72	84.7
Lack of technical support	69	81.2
Insufficient training in blended pedagogy	68	80.0
Limited time for course development	71	83.5
Increased workload	67	78.8
Student digital illiteracy	60	70.6
Lack of administrative support	58	68.2
Preference for traditional teaching	37	43.5
Uncertainty about effectiveness	42	49.4
Resistance to change	35	41.2
Inadequate financial resources	65	76.5
Difficulty assessing online participation	54	63.5

Instructor barrier reports largely paralleled student perspectives while emphasizing institutional and pedagogical dimensions. Internet connectivity challenges were nearly universal among instructors (78, 91.8%), as were concerns about insufficient institutional computers (76, 89.4%), unreliable electricity (73, 85.9%), and inadequate learning management systems (72, 84.7%). These infrastructure barriers affect both students and instructors, impeding all aspects of blended learning delivery.

Instructors particularly emphasized capacity-building needs. Insufficient training in blended learning pedagogy was reported by 68 instructors (80.0%), indicating that most faculty feel unprepared to design and deliver effective blended courses despite general teaching expertise. Limited time for course development (71 instructors, 83.5%) and increased workload concerns (67 instructors, 78.8%) reflect realistic understanding that transitioning to blended delivery demands substantial upfront investment that current workload structures may not accommodate. Lack of technical support was identified by 69 instructors (81.2%), suggesting inadequate assistance for troubleshooting technology problems, developing digital materials, or learning new platforms.

Interestingly, instructor self-reported resistance was relatively modest, with preference for traditional teaching reported by 37 instructors (43.5%) and resistance to change by 35 (41.2%), proportions lower than student perceptions of instructor unwillingness (52.7%). This discrepancy may reflect that while some instructors genuinely resist change, others' apparent reluctance actually stems from feeling inadequately prepared, supported, or resourced rather than from principled opposition to blended learning. Student digital illiteracy was perceived as a barrier by 60 instructors (70.6%), indicating instructor recognition that implementation success depends on student capacity building alongside faculty development.

Administrative and institutional barriers included inadequate financial resources (65 instructors, 76.5%) and lack of administrative support (58 instructors, 68.2%), suggesting that implementation requires not merely instructor initiative but institutional commitment, investment, and policy frameworks creating enabling environment for innovation.

Qualitative Findings on Perceived Effectiveness and Barriers

Thematic analysis of class delegate interviews revealed four major themes elaborating and contextualizing quantitative findings: infrastructure deficiencies, pedagogical concerns and uncertainties, resource limitations and inequities, and resistance to change and cultural factors.

Theme 1: Infrastructure Deficiencies

All 12 class delegates emphasized infrastructure inadequacies as fundamental implementation barriers. Internet connectivity emerged as the most consistently mentioned challenge. One delegate explained, *"The internet here is very unstable. Sometimes you can access materials, sometimes you cannot. During online classes, the connection drops repeatedly, making learning very frustrating"* (Delegate 3, FHS-UB). Another elaborated on cost barriers: *"Even when internet is available, the cost is too high for most students. We have to choose between buying data bundles and buying food. It's not sustainable"* (Delegate 7, BUIB).

Electricity supply challenges were graphically described. One delegate noted, *"Power cuts happen almost daily, sometimes for many hours. If you plan to study online in the evening, suddenly there's no power. You cannot charge your computer or phone. Everything stops"* (Delegate 5, RHIBMS). Another connected electricity problems to device limitations: *"Without reliable electricity, even if you have a laptop, the battery dies quickly. Most students only have phones, which are not ideal for serious academic work, and phones also need charging"* (Delegate 10, FHS-UB).

Technology infrastructure at institutions was described as inadequate. One delegate observed, *"The computer laboratories have too few computers for the number of students. If you have online assignment due, you have to wait hours for your turn, or come very early in the morning"* (Delegate 2, BUIB). Another added, *"The computers that are available are often old, slow, and frequently broken. Technical support is limited, so repairs take long time"* (Delegate 11, RHIBMS).

Despite these challenges, delegates acknowledged potential effectiveness if infrastructure were adequate. One stated, *"If we had reliable internet and electricity, blended learning would be very beneficial. We could access materials anytime, learn at our pace, review difficult concepts repeatedly. The problem is not the idea of blended learning, but the infrastructure reality"* (Delegate 6, FHS-UB). This nuanced perspective demonstrates that skepticism about blended learning implementation stems from practical infrastructure concerns rather than rejection of pedagogical innovation.

Theme 2: Pedagogical Concerns and Uncertainties

Delegates expressed concerns about pedagogical dimensions of blended learning, particularly regarding clinical nursing education. One delegate articulated, *"Nursing is not just theory, it's hands-on practice. We need to learn how to give injections, dress wounds, handle patients. You cannot learn these skills from watching videos online. We need face-to-face demonstration and supervised practice"* (Delegate 4, RHIBMS). This concern reflects appropriate recognition of nursing education's unique requirements.

However, delegates simultaneously recognized blended learning potential for theoretical content. One explained, *"For subjects like anatomy, physiology, pharmacology, blended learning could work well. These are theory-based. We can read materials online, watch educational videos, do online quizzes. Then face-to-face time can be used for discussion and clarifying difficult concepts"* (Delegate 8, BUIB). This distinction between theoretical and clinical content aligns with quantitative findings showing high effectiveness ratings for theory but low ratings for clinical skills.

Concerns about interaction quality emerged repeatedly. One delegate worried, *"In traditional classes, when you don't understand something, you can immediately ask the instructor, see their face, observe their demonstrations. In online learning, there's a barrier. You send message and wait for reply, but it's not the same as face-to-face interaction"* (Delegate 1, FHS-UB). Another added, *"Nursing education includes professional values, caring attitudes, ethical behavior. These things are learned through observing instructors, interacting with them, modeling their behavior. I'm not sure this can happen effectively online"* (Delegate 9, RHIBMS).

Some delegates expressed uncertainty about learning effectiveness in blended environments. One admitted, *"I don't know if I would learn as well with blended approach. In class, I'm focused and engaged. At home, there are many distractions – family members, noise, household responsibilities. I worry I wouldn't be disciplined enough for self-paced learning"* (Delegate 12, BUIB). This honest assessment reflects concerns about self-regulation demands that blended learning imposes.

Theme 3: Resource Limitations and Inequities

Delegates emphasized socioeconomic disparities affecting blended learning readiness. One delegate observed, *"Not all students can afford smartphones or laptops. Some share phones with family members. Some have very basic phones that cannot run applications needed for online learning. If blended learning is implemented, these students will be left behind"* (Delegate 5, RHIBMS). Another elaborated, *"Students from wealthy families have personal computers, unlimited home internet, quiet study spaces. Students from poor families have none of these. Blended learning will increase inequality unless institutions provide resources to disadvantaged students"* (Delegate 3, FHS-UB).

Digital literacy disparities were also noted. One delegate explained, *"Some students are very comfortable with technology, they use computers since childhood. Others are using computers for first time in nursing school. If we suddenly shift to blended learning, students with weak technology skills will struggle while others thrive"* (Delegate 7, BUIB). This observation underscores the importance of addressing digital literacy systematically rather than assuming uniform student competence.

Institutional resource limitations extended beyond infrastructure. One delegate noted, *"Even if institution wants to implement blended learning, where will funding come from? Developing quality online materials costs money. Providing instructors with training costs money. Expanding internet bandwidth costs money. Our institutions already struggle financially"* (Delegate 6, FHS-UB). This realistic assessment reflects broader resource constraints affecting African higher education institutions.

Despite concerns about inequities, some delegates saw potential for blended learning to reduce certain disparities. One suggested, *"Blended learning could actually help students who live far from campus. Transportation costs are high and time-consuming. If some learning can happen online from home, this saves money and time, especially helping students from distant areas"* (Delegate 10, RHIBMS). This perspective demonstrates nuanced understanding that while blended learning may exacerbate some inequities (technology access), it may ameliorate others (geographic distance).

Theme 4: Resistance to Change and Cultural Factors

Delegates described resistance to blended learning among some instructors and students rooted in comfort with traditional approaches. One delegate observed, *"Some instructors have taught the same way for many years. They are comfortable with traditional lectures. Blended learning requires learning new skills, changing teaching methods, investing time in course redesign. Some instructors simply don't want to make this effort"* (Delegate 2, BUIB). Another added, *"We have instructors who barely use PowerPoint, preferring chalk and blackboard. Expecting them to suddenly embrace online platforms and multimedia resources is unrealistic without strong motivation and support"* (Delegate 11, FHS-UB).

Student resistance also existed, though less prominently. One delegate explained, *"Some students prefer traditional methods because that's what they're used to. They know how to succeed in traditional system – attend lectures, take notes, memorize for exams. Blended learning changes the rules, requiring different study skills, and this creates anxiety"* (Delegate 4, RHIBMS). This observation reflects that change, even potentially beneficial change, generates uncertainty and resistance.

Cultural factors related to authority and pedagogy emerged. One delegate noted, *"In our culture, the teacher is the authority who transmits knowledge to students. Blended learning, especially online self-paced components, shifts responsibility to students for their own learning. This cultural shift is uncomfortable for some instructors and students who are used to teacher-centered education"* (Delegate 8, BUIB). Another elaborated, *"Face-to-face instruction allows instructors to maintain authority and control. Online learning feels less controlled –*

students can access materials anytime, progress at different rates, communicate informally through chat. Some instructors worry about losing authority" (Delegate 9, FHS-UB).

However, delegates also described openness to change among younger instructors and students. One observed, *"Younger instructors who recently completed their own education are more comfortable with technology and open to innovation. They understand that education must evolve with technology"* (Delegate 1, RHIBMS). Similarly, another noted regarding students, *"Most of my classmates are excited about the possibility of blended learning. We use technology constantly in our personal lives. We're ready to use it for education if institutions provide the infrastructure and training"* (Delegate 7, BUIB). This generational openness provides optimistic foundation for gradual change.

Associations Between Perceived Effectiveness and Participant Characteristics

Chi-square analysis examined relationships between perceived effectiveness and participant characteristics among students. Table 7 presents these associations.

Characteristic	**Effective**	**Ineffective**	**p-value**
	n (%)	**n (%)**	
Gender			0.287
Male	142 (95.9)	6 (4.1)	
Female	231 (97.5)	6 (2.5)	
Academic Level			**0.018**
First Year	104 (92.9)	8 (7.1)	
Second Year	96 (98.0)	2 (2.0)	
Third Year	113 (98.3)	2 (1.7)	
Fourth Year	60 (100.0)	0 (0.0)	
Institution			**0.029**
BUIB	178 (98.9)	2 (1.1)	
FHS-UB	122 (97.6)	3 (2.4)	
RHIBMS	73 (91.3)	7 (8.8)	
Prior Technology			**0.003**
Yes	293 (98.3)	5 (1.7)	
No	80 (92.0)	7 (8.0)	

Academic level showed significant association with perceived effectiveness (χ^2=10.12, p=0.018). Effectiveness perceptions increased progressively across academic levels, from 92.9% in first year to 100% in fourth year. This pattern suggests that as students advance through nursing programmes, gaining educational maturity, technology experience, and professional perspective, appreciation for blended learning benefits strengthens. Advanced students may better recognize how flexibility, resource access, and technology skills will benefit their future practice.

Institutional affiliation was significantly associated with effectiveness perceptions (χ^2=7.08, p=0.029). BUIB students demonstrated highest effectiveness perceptions (98.9%), followed by FHS-UB (97.6%), while RHIBMS showed lower perceptions (91.3%). These institutional differences may reflect varying technology exposure, different instructor emphases on digital learning, or infrastructure quality differences affecting students' realistic assessment of implementation feasibility.

Prior technology experience showed strong association with effectiveness perceptions (χ^2=8.92, p=0.003). Students with previous technology exposure demonstrated substantially higher effectiveness perceptions (98.3%) compared to those without such experience (92.0%). While both groups were predominantly positive, technology familiarity appears to strengthen confidence that blended learning can be implemented effectively, possibly by reducing anxiety about technical competence.

No significant association emerged between gender and effectiveness perceptions (p=0.287), indicating that male and female students hold similarly positive views about blended learning potential, contrasting with the gender differences observed for knowledge levels in the companion manuscript.

DISCUSSION

This mixed-methods study comprehensively investigated perceived effectiveness and barriers influencing blended learning implementation in Cameroonian nursing education. The findings reveal strong stakeholder belief in blended learning potential coexisting with substantial infrastructure, resource, and capacity barriers that currently impede effective implementation. The integration of quantitative prevalence data with qualitative experiential depth provides nuanced understanding essential for planning contextually appropriate implementation strategies.

The finding that 96.9% of students and 91.8% of instructors perceive blended learning as effective overall demonstrates remarkable consensus supporting pedagogical innovation in Cameroonian nursing education. These proportions exceed many international studies, where effectiveness perceptions typically range from 70-85% (McCutcheon et al., 2015; Rowe et al., 2020). The particularly strong endorsement in this Buea sample likely reflects multiple factors. Students and instructors experiencing limitations of traditional approaches in resource-constrained settings, including large classes, insufficient library materials, limited instructor-student interaction time, and restricted access to current literature, may more readily recognize blended learning's potential to address these challenges (Porter et al., 2016). Additionally, the COVID-19 pandemic's legacy includes heightened awareness of digital learning possibilities and recognition that technology competence is increasingly essential for professional practice (Dewart et al., 2020).

Importantly, effectiveness perceptions were nuanced rather than uniformly optimistic. The clear distinction between theoretical content (perceived as highly suitable for blended delivery by more than 90% of both students and instructors) and clinical skills (perceived as suitable by only 25-27%) demonstrates appropriate pedagogical sophistication. This realistic assessment aligns with nursing education literature consistently finding that while blended approaches effectively enhance theoretical knowledge, critical thinking, and clinical reasoning, hands-on psychomotor skills require supervised in-person practice (Liu et al., 2016; Vallée et al., 2020). The overwhelming rejection of blended learning as replacement for face-to-face instruction (only 3.1% endorsement) further demonstrates pragmatic understanding that blended approaches should complement rather than substitute traditional pedagogy, particularly critical in nursing education where professional socialization, empathetic communication, and supervised patient care remain irreplaceable components.

The strong correlation between academic level and effectiveness perceptions, with progressive increases from first through fourth year, suggests that educational maturity and accumulated experience enhance appreciation of blended learning benefits. Advanced students may better recognize how flexibility accommodates clinical placement schedules, how digital resources support evidence-based practice development, and how technology skills transfer to professional contexts. This pattern suggests that early-programme implementation may encounter more skepticism than later-programme implementation, or conversely, that early positive experiences with blended learning could accelerate acceptance across cohorts.

The barrier findings reveal formidable implementation challenges that enthusiasm alone cannot overcome. Infrastructure barriers, particularly poor internet connectivity (reported by 89.6% of students and 91.8% of instructors), high internet costs (86.8% of students), and unreliable electricity (78.4% of students, 85.9% of instructors), represent fundamental obstacles that technological pedagogical strategies cannot circumvent. These findings align consistently with African blended learning literature documenting infrastructure as the primary implementation barrier across diverse contexts including Kenya, South Africa, Tanzania, and Ghana (Lwoga, 2014; Kintu et al., 2017; Mtebe & Raisamo, 2014; Antwi et al., 2021). Cameroon's infrastructure challenges, including expensive limited-bandwidth internet concentrated in urban areas, frequent extended power outages, and inadequate backup power systems at many institutions, create environment where even well-designed blended learning initiatives struggle to function reliably (Fozdar et al., 2006).

The qualitative findings vividly illustrated infrastructure barrier impacts. Delegates' descriptions of repeatedly dropped connections during online classes, impossible choices between purchasing internet data versus food, and studying cut short by sudden power outages reveal how infrastructure inadequacies translate into daily frustrations that undermine learning continuity and engagement. These experiential accounts contextualize

quantitative prevalence data, demonstrating that infrastructure barriers represent not abstract statistical frequencies but lived realities fundamentally affecting students' ability to participate in blended learning.

Human capacity barriers, including insufficient digital literacy (63.6% of students, 70.6% noted by instructors), lack of blended learning training (69.4% of students, 80.0% of instructors), and time management challenges (63.1% of students), represent another critical barrier category amenable to intervention through systematic capacity building. The finding that 80% of instructors report no formal training in blended learning pedagogy is particularly concerning, as instructor competence substantially determines implementation quality (Rasheed et al., 2020). Simply providing technology without developing pedagogical competence for technology-enhanced instruction risks superficial implementation where instructors merely post lecture notes online rather than leveraging interactive, multimedia, student-centered approaches that characterize effective blended learning (Porter et al., 2016).

Student digital literacy gaps, acknowledged by both students themselves and instructors, reflect broader patterns where familiarity with social media and entertainment technologies does not automatically translate to academic technology competencies including navigating learning management systems, evaluating online information quality, collaborating effectively in virtual environments, or managing digital workflow (Rasheed et al., 2020). Addressing these gaps requires explicit digital literacy instruction integrated throughout nursing programmes rather than assuming competencies students may not possess.

Resource barriers, including insufficient devices (81.3% of students), inadequate learning management systems (72.2% of students, 84.7% of instructors), and lack of technical support (75.1% of students, 81.2% of instructors), underscore that blended learning implementation requires substantial institutional investment extending beyond instructor enthusiasm or student willingness. The qualitative theme of resource limitations and inequities poignantly revealed how socioeconomic disparities affect blended learning readiness, with delegates describing classmates who share phones with family members, lack personal computers, or have only basic phones incapable of running required applications. This reality raises profound equity concerns: implementing blended learning without ensuring equitable technology access risks exacerbating educational inequalities, advantaging already-privileged students while further disadvantaging those from lower-income backgrounds (Porter et al., 2016).

Resistance to change, while present among approximately 40-50% of instructors and students based on quantitative data, appeared less monolithic in qualitative exploration. Delegates described resistance rooted not in principled opposition to innovation but in pragmatic concerns about inadequate preparation, insufficient support, increased workload without recognition or compensation, and uncertainty about effectiveness given infrastructure realities. This nuanced understanding suggests that apparent resistance may diminish substantially if implementation is accompanied by adequate training, technical support, workload accommodation, and phased approaches allowing gradual adaptation rather than abrupt wholesale change (Khalid, 2012).

Cultural factors identified qualitatively, including traditional teacher-centered pedagogical norms and hierarchical authority structures, represent subtler but potentially significant implementation influences. Blended learning's emphasis on student-centered approaches, independent learning, and instructor roles as facilitators rather than sole knowledge authorities represents cultural shift that some stakeholders find uncomfortable (Mtebe & Raisamo, 2014). However, delegates also described generational differences, with younger instructors and students generally more receptive to pedagogical innovation and comfortable with technology integration. This generational openness suggests that cultural barriers may gradually diminish as new cohorts enter nursing education and practice.

The associations between effectiveness perceptions and prior technology experience (significant) and academic level (significant) but not gender (non-significant) provide insights for targeting implementation support. Technology familiarity appears to strengthen confidence in blended learning feasibility, reinforcing arguments for integrating digital literacy development early in nursing curricula (Al-Fraihat et al., 2020). The progressive increase in effectiveness perceptions across academic levels suggests that advanced students, having accumulated educational experience and developed greater professional perspective, better appreciate blended learning benefits. Gender similarity in effectiveness perceptions, contrasting with gender differences in

knowledge observed in the companion manuscript, suggests that while knowledge acquisition may show gender disparities, actual receptivity to innovation is equally strong across genders when students understand blended learning concepts.

Several study strengths merit acknowledgement. The mixed-methods design provided comprehensive understanding integrating quantitative breadth with qualitative depth, revealing nuances that neither approach alone could capture. The large, multi-institutional quantitative sample enhanced representativeness and statistical power. High response rates among both students (100%) and instructors (94.4%) minimized non-response bias. The inclusion of multiple stakeholder perspectives (students, instructors, class delegates) provided triangulation strengthening confidence in findings. The use of both established instruments and contextually developed items ensured cultural appropriateness while maintaining measurement rigor.

However, limitations warrant consideration. The cross-sectional design captured perceptions at a single timepoint without tracking how perceptions might evolve as implementation proceeds or circumstances change. Initial expectations may differ from actual experiences once the program is fully implemented; Participants' current views were based on perceptions, which may change as they face the practical, day-to-day realities of the project. Therefore, these findings represent subjective reports rather than final, real-world outcomes. The Buea-specific context limits generalizability to other Cameroonian regions with different infrastructure or other African countries with varying educational systems and resources. Social desirability bias may have inflated positive responses, although the honest acknowledgement of numerous barriers suggests respondents felt comfortable expressing concerns. The qualitative sample, while providing valuable depth, was relatively small and limited to class delegates rather than including diverse student voices.

CONCLUSION

This study demonstrates that Cameroonian nursing stakeholders perceive blended learning as potentially highly effective for enhancing educational flexibility, expanding resource access, developing technology skills, and improving theoretical knowledge delivery, while appropriately recognizing limitations for clinical skills instruction. However, substantial barriers related to technological infrastructure, human capacity, institutional resources, and sociocultural factors currently impede effective implementation. The coexistence of strong effectiveness perceptions with formidable implementation barriers creates both opportunity and challenge: opportunity because stakeholder receptivity provides essential foundation for innovation, challenge because enthusiasm alone cannot overcome practical obstacles requiring substantial, sustained intervention.

For nursing education practice, these findings support pursuing blended learning implementation through carefully phased, adequately resourced approaches rather than wholesale rapid transitions. Initial implementation should focus on theoretical courses where effectiveness is most evident, using blended approaches to complement rather than replace face-to-face clinical instruction. Institutions should prioritize infrastructure development, including reliable internet connectivity, backup power systems, adequate devices, and robust learning management systems, recognizing that pedagogical innovation depends on technological foundation. Comprehensive capacity building must address both student digital literacy and instructor pedagogical competence through systematic training programmes, ongoing technical support, and mentorship from technology-proficient colleagues.

For policy, findings emphasize the need for substantial investment in educational technology infrastructure at institutional, regional, and national levels. Government policies should address internet accessibility and affordability through subsidized educational data plans, incentivized internet service provider expansion to underserved areas, and public investment in robust connectivity infrastructure. Electricity reliability requires parallel attention through grid improvements, institutional backup power systems, and alternative energy solutions. Equity considerations demand policies ensuring disadvantaged students receive necessary devices, connectivity support, and digital literacy development to prevent blended learning from exacerbating socioeconomic educational disparities.

Institutional policies should create enabling environments for blended learning through technology acquisition budgets, faculty development programmes, workload recognition for course redesign efforts, technical support

staff expansion, and incentive structures rewarding pedagogical innovation. Flexible curriculum policies accommodating blended delivery alongside traditional approaches, rather than rigid either-or frameworks, facilitate gradual sustainable transitions respecting stakeholder readiness while promoting continuous improvement.

Future research should investigate actual blended learning implementation experiences in Cameroonian nursing programmes, moving beyond perceptions to examine real-world effectiveness, challenges encountered, and strategies for addressing barriers. Longitudinal studies tracking effectiveness perceptions, barrier prevalence, and implementation outcomes across time would illuminate adaptation processes and identify critical success factors. Intervention research testing specific barrier-reduction strategies, such as structured faculty development programmes, student digital literacy curricula, or infrastructure enhancement initiatives, would provide actionable evidence for implementation planning. Comparative studies examining different blended learning models, delivery technologies, and implementation approaches would identify configurations best suited to resource-constrained African contexts.

Qualitative research exploring stakeholder experiences during actual blended learning implementation, particularly attending to cultural dimensions, resistance mechanisms, and adaptation strategies, would provide nuanced understanding informing culturally responsive implementation. Investigation of learning outcome differences between traditional, blended, and fully online nursing education in Cameroonian contexts, carefully accounting for selection biases and confounding variables, would address fundamental questions about educational effectiveness. Research examining specific barrier mitigation strategies, such as mobile-optimized platforms accommodating smartphone-dependent learners or offline-capable systems functioning despite connectivity interruptions, would inform technology selection for resource-constrained contexts. Finally, exploration of sustainable financing models supporting educational technology infrastructure development and maintenance in resource-limited settings represents critical research direction with broad applicability beyond Cameroon to similar African contexts.

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Conflicts of Interest

The Researchers declare no conflict of interest

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