Enhancing Anatomy Knowledge among First-Year Nursing Students Using a Flipped Classroom Approach: A Quasi-Experimental Study at the University of Kabianga

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DOI: https://dx.doi.org/10.47772/IJRISS.2025.903SEDU0384

Received: 22 June 2025; Revised: 02 July 2025; Accepted: 05 July 2025; Published: 05 August 2025

ABSTRACT

Anatomy forms the cornerstone of nursing education, yet many students struggle with retention and clinical application of anatomical concepts. This study evaluated the effectiveness of a flipped classroom approach using lecturer-generated YouTube videos shared via WhatsApp in improving anatomy knowledge among first-year Bachelor of Science in Nursing students at the University of Kabianga. A quasi-experimental one-group pretest-posttest design was conducted among 64 first-year nursing students. The intervention involved sharing weekly YouTube videos created by the lecturer through a class WhatsApp group. In-person sessions followed the regular teaching timetable and focused on clarifying concepts, group discussions, and application using anatomical models. Video content was created using micro-learning principles (under 10 minutes) and peer-reviewed for accuracy. Student engagement was tracked through WhatsApp responses and in-class quizzes. The intervention ran for 11 teaching weeks, excluding CAT 1 and CAT 2 weeks. A pretest was conducted during CAT 1 and a posttest during CAT 2. Paired t-tests were used for statistical analysis. The mean pretest score was 41.7%, which significantly improved to 66.7% in the posttest ($t = 31.00$, $p < 0.001$), indicating substantial gains in anatomy knowledge. The flipped classroom strategy combining YouTube and WhatsApp significantly improved anatomy learning outcomes among first-year nursing students. This low-cost, blended learning approach is recommended for adoption in nursing education at the University of Kabianga.

Keywords: Flipped Classroom, Anatomy Education, Nursing Students, University of Kabianga

BACKGROUND TO THE STUDY

Anatomy is a foundational subject in nursing education, underpinning clinical reasoning and safe patient care delivery. Mastery of anatomical knowledge is essential for Registered Nurses to understand pathophysiology, perform clinical assessments, and implement interventions effectively (Perry et al., 2022). However, despite its significance, anatomy remains one of the most challenging courses for nursing students, often associated with high cognitive load, abstract content, and rote memorization (Wilson et al., 2021).

Traditional lecture-based approaches, which remain predominant in many institutions, including in low- and middle-income countries, have been criticized for promoting passive learning, poor engagement, and limited retention of anatomical knowledge (Nwachukwu et al., 2023). In response, educational reforms have increasingly focused on active learning strategies, including flipped classroom models, simulation, and digital learning, to enhance comprehension and application (Khanova et al., 2020).

The flipped classroom model, which involves delivering content outside class and using class time for active engagement, has gained traction globally. In nursing education, it has been associated with improved knowledge acquisition, higher student satisfaction, and enhanced critical thinking (Kivunja, 2021; Jamshidi et al., 2022). Its flexibility and adaptability make it particularly useful in resource-limited settings where internet access may be intermittent, and classroom time constrained.

In Kenya, there is growing interest in integrating blended learning approaches at the university level, yet few published studies evaluate their impact in core subjects like anatomy among nursing students. This study, therefore, implemented a flipped classroom strategy using YouTube videos shared via WhatsApp to assess its effectiveness in improving anatomy knowledge at the University of Kabianga

Problem Statement

Despite anatomy being a cornerstone of nursing education, many first-year nursing students at the University of Kabianga continue to exhibit poor performance and limited ability to apply anatomical knowledge in clinical contexts. This challenge is exacerbated by conventional lecture-based teaching methods that do not sufficiently engage learners or support active, contextual learning. Consequently, students struggle with both knowledge retention and clinical relevance: issues reported across many nursing programs in sub-Saharan Africa (Omoke et al., 2022).

In the era of digital transformation, evidence from international and regional studies suggests that flipped classroom models can significantly improve student engagement and academic outcomes in science-based subjects (Zainuddin & Attaran, 2021). However, locally contextualized evidence on the effectiveness of such innovative teaching strategies in Kenyan nursing schools is still sparse.

There is, therefore, a need to evaluate low-cost, technology-driven interventions that can enhance learning without requiring extensive infrastructure investment. This study addresses that gap by assessing the effectiveness of a flipped classroom strategy using lecturer-created YouTube content disseminated via WhatsApp on the anatomy performance of first-year BSc Nursing students at the University of Kabianga.

Objectives of the Study

The overall objective of this study is to assess the effectiveness of a flipped classroom approach in enhancing anatomy knowledge among first-year Bachelor of Science in Nursing students at the University of Kabianga.

Specific Objectives:

1. To determine the baseline level of anatomy knowledge among first-year nursing students.
2. To implement a flipped classroom strategy using YouTube video lessons delivered via WhatsApp.
3. To evaluate the change in students' anatomy knowledge after the flipped classroom intervention.
4. To assess students' perceptions of the flipped classroom approach in learning anatomy.

Research Questions

1. What is the baseline level of anatomy knowledge among first-year nursing students prior to the flipped classroom intervention?
2. What is the effect of flipped classroom approach in improving anatomy knowledge among nursing students?
3. What change in test performance is observed between pre- and post-intervention assessments?
4. What are the students' perceptions of using YouTube videos and WhatsApp in learning anatomy through a flipped classroom model?

Null Hypothesis (H_0):

There is no difference in the anatomy knowledge scores of first-year nursing students before and after the flipped classroom intervention.

Alternative Hypothesis (H_1):

There is improvement in the anatomy knowledge scores of first-year nursing students after the flipped classroom intervention.

Justification of the Study

Anatomy forms the cornerstone of nursing education, providing essential knowledge for understanding human body structure and its application in clinical practice. However, many nursing students face challenges in mastering anatomy due to its inherent complexity and the limitations of traditional lecture-based methods. This study is justified by its potential to improve student learning outcomes through the adoption of a flipped classroom model, offering empirical evidence on how active learning strategies can enhance comprehension and retention among first-year nursing students. By utilizing accessible digital tools such as YouTube and WhatsApp, the study also promotes educational innovation in resource-limited settings, demonstrating a scalable and cost-effective teaching approach particularly suited for institutions in sub-Saharan Africa. Furthermore, the findings are expected to inform curriculum development at the University of Kabianga and similar institutions by supporting the integration of blended learning into foundational science courses. In addition to evaluating academic performance, the study explores student perceptions, thereby offering valuable insights into engagement, motivation, and learner autonomy. Lastly, the research contributes to the nursing education literature by addressing a local evidence gap and enriching the global discourse on flipped learning within health sciences education.

Theoretical Framework of the study

This study is grounded in Patricia Benner's Novice to Expert Theory, which posits that nursing competence develops in stages, beginning with the novice level where learners rely heavily on formal instruction and rules (Benner, 1984). First-year nursing students, as novices, require structured, repetitive, and contextual learning to develop foundational knowledge that can later be applied in clinical settings. The flipped classroom strategy aligns with this theoretical perspective by allowing students to engage with basic anatomy concepts through asynchronous video content before attending in-person sessions for discussion, clarification, and application. This model fosters incremental learning, consistent with the novice stage's need for support and exposure to varied learning modalities. By integrating technology and promoting active learning, the intervention supports a smoother transition from theoretical understanding to practical clinical reasoning.

LITERATURE REVIEW

Anatomy is widely recognized as a critical component of nursing education, laying the groundwork for students to understand the structure and function of the human body in clinical practice. Mastery of anatomical knowledge is linked to improved clinical reasoning and safe patient care, particularly in tasks such as administering injections, catheterization, and conducting physical assessments (Perry et al., 2022). However, many nursing students report difficulties learning anatomy due to its abstract content, extensive volume, and the limited interactivity of traditional teaching approaches (Wilson et al., 2021).

Conventional lecture-based instruction remains the dominant method in many Kenyan and African institutions, yet this passive learning style has been associated with low student engagement, poor knowledge retention, and underwhelming academic performance (Nwachukwu et al., 2023). In response to these challenges, there has been a global shift toward more interactive, student-centered teaching methods (Phyllis et al., 2021). Among these, the flipped classroom model has emerged as a promising pedagogical approach. This method involves students first engaging with pre-class content, often in the form of videos or readings, before attending class sessions focused on active learning, discussions, and practical application (Bishop & Verleger, 2020).

Evidence from nursing and health sciences education supports the effectiveness of the flipped classroom. A meta-analysis by Jamshidi et al. (2022) demonstrated that students taught through flipped learning consistently outperformed their peers in traditional settings in terms of academic achievement and satisfaction. Khoshhal et al. (2021) further reported that Iranian nursing students enrolled in flipped anatomy classes showed improved understanding and recall compared to those receiving standard lectures.

The integration of technology has played a crucial role in facilitating flipped learning. Tools such as YouTube, WhatsApp, and other mobile platforms offer flexible, self-paced learning opportunities, which are especially

useful in resource-constrained settings. Zainuddin and Attaran (2021) emphasized that these technologies enable affordable, scalable teaching models that align well with the needs of students in sub-Saharan Africa, where smartphone use and internet access are rapidly expanding.

Despite this promising evidence, most research on flipped classrooms has been conducted in high-income countries, with limited studies from African contexts especially global south countries like Kenya. Local investigations have largely centered on general e-learning and the expensive simulation tools, leaving a gap in the literature regarding the effectiveness of low-cost, mobile-based flipped learning strategies for anatomy instruction (Omoke et al., 2022). Therefore, there is a pressing need to generate context-specific data to guide the adoption of flipped classroom approaches in nursing education within Kenyan settings.

METHODOLOGY

Study Design

This study adopted a quasi-experimental pre-test post-test design without a control group. This design enabled the researcher to measure the effectiveness of a flipped classroom intervention by comparing students' anatomy knowledge scores before and after the intervention.

Study Site

The study was conducted at the University of Kabianga, Kericho County, Kenya, among first-year Bachelor of Science in Nursing (BScN) students enrolled in the academic year 2024/2025. The institution is a public university offering health sciences programs, including nursing, with a structured curriculum in human anatomy taught during the first year.

Study Population

The target population comprised first-year BSc Nursing students at the University of Kabianga who were undertaking the anatomy course during the study period.

Sample Size and Sampling Procedure

A census sampling approach was used, including all 64 students enrolled in the first-year BSc Nursing class of 2024/2025.

Inclusion criteria were:

- Active enrollment in the anatomy course.
- Availability and consent to participate in both pre- and post-tests.

Intervention

The flipped classroom intervention was implemented over 11 teaching weeks, excluding weeks for Continuous Assessment Tests (CATs). The steps were as follows:

1. Pre-Test (Week 1): Students undertook a structured multiple-choice test assessing baseline anatomy knowledge.
2. Video-Based Learning (Weeks 2–11): The instructor developed and uploaded short YouTube video lectures covering core anatomy topics. Links were shared with students via WhatsApp, along with prompts to review the content before class.
3. In-Class Physical Sessions: Timetabled face-to-face lessons were used for active engagement through question-answer sessions, clinical application discussions, peer-teaching, and short quizzes.
4. Post-Test (Week 12): Students completed a similar test to evaluate improvement in knowledge.

Data Collection Tools

- Structured MCQ Tests: Administered before and after the intervention to measure knowledge acquisition.
- Student Feedback Questionnaire: Designed to collect students' perceptions on the effectiveness and usability of the flipped classroom approach, including technology delivery via WhatsApp.

Data Analysis

Quantitative data from pre- and post-tests were analyzed using SPSS Version 25. Descriptive statistics (means, frequencies) and paired t-tests were used to assess statistical significance in score improvement. Perception data from the feedback questionnaire were analyzed using descriptive statistics and thematic categorization for open-ended responses.

Ethical Considerations

Students gave written informed consent. Participation was voluntary and did not affect their academic grading. Anonymity and confidentiality were maintained using coded identifiers instead of names.

RESULTS

Participant Characteristics

A total of 64 first-year BSc Nursing students from the University of Kabianga participated in the study. The mean age of participants was not assessed as part of the intervention, but all were enrolled in the 2024/2025 cohort.

Pretest and Posttest Performance

Pretest (CAT 1) and posttest (CAT 2) scores were recorded out of 100. The table below summarizes the central tendency of scores:

Table 1: Pre- and Posttest Scores Summary

Test	Mean Score (%)	Standard Deviation (SD)
Pretest (CAT 1)	41.7	6.5
Posttest (CAT 2)	66.7	7.8

Table 2: Paired Samples t-Test Results

Paired Samples Summary Statistics

Statistic	Value
Mean Difference	26.71
Standard Deviation (SD)	9.49
Standard Error of Mean (SE)	1.186

A paired samples t-test showed a statistically significant improvement in anatomy knowledge after the flipped classroom intervention: $t(63) = 31.00$, $p < 0.001$

Test	t-Statistic	Degrees of Freedom (df)	p-Value	Significance	Conclusion
Paired t-test	22.53	63	< 0.001	Significant	Knowledge gain is statistically significant

This indicates a substantial gain in knowledge following the intervention.

Qualitative Feedback from Participants

Open-ended responses from the feedback questionnaire were analyzed thematically, revealing three overarching themes that provide deeper insight into students' experiences with the flipped classroom model:

1. Positive Experiences with the Flipped Model: A majority of students valued the flexibility the model provided. They highlighted the ability to control their pace of learning, revisit challenging content, and arrive at in-person sessions better prepared. One student noted, "Watching the videos before class helped me understand better during discussion time." Another echoed, "It was less stressful, and I could pause and repeat parts I didn't understand."
2. Challenges Encountered: Several students reported logistical difficulties such as unreliable internet connectivity, lack of access to smartphones or laptops, and limited data bundles. In addition, a few expressed challenges with self-discipline, stating that without scheduled reminders, it was easy to procrastinate. One participant commented, "Sometimes I didn't have bundles to watch the videos on time," while another added, "It was hard to stay consistent without someone checking in."
3. Suggestions for Improvement: Students offered constructive ideas for enhancing the flipped classroom experience. These included: Embedding short quizzes at the end of each video to reinforce key concepts and maintain engagement. Keeping video lessons under 10 minutes to cater to short attention spans and reduce data costs. Improving WhatsApp communication by using pinned messages, scheduled reminders, and summary infographics to organize content accessibly and consistently.

DISCUSSION

This study demonstrated a statistically significant improvement in anatomy knowledge among first-year nursing students following the implementation of a flipped classroom approach at the University of Kabianga. The intervention, which utilized lecturer-created YouTube videos disseminated via WhatsApp, empowered students to engage with core anatomical concepts independently before participating in structured, interactive classroom sessions. The notable increase in mean scores from 41.7% (pretest) to 66.7% (posttest), as supported by a highly significant paired samples t-test ($t(63) = 31.00$, $p < 0.001$), reinforces the flipped classroom model's potential to enhance academic outcomes in foundational science courses.

These findings align with a growing body of literature underscoring the pedagogical benefits of flipped learning in health sciences education. For example, Jamshidi et al. (2022) conducted a meta-analysis that revealed consistent academic performance and satisfaction gains among students exposed to flipped classrooms, compared to those in traditional lecture settings. Similarly, Khoshhal et al. (2021) demonstrated that nursing students engaged in flipped anatomy instruction exhibited superior retention and understanding than their counterparts in conventional courses. Such evidence supports the assertion that flipped classrooms foster deeper engagement, better preparation, and more active learning hallmarks of effective nursing education.

The present study also contributes to the discourse by validating the practicality of low-cost, mobile-enabled platforms particularly WhatsApp and YouTube in delivering flipped content within resource-limited educational environments. This echoes the findings of Zainuddin and Attaran (2021), who highlighted the adaptability and scalability of mobile learning in supporting student-centered instruction across the Global South. By promoting autonomy, accountability, and collaborative learning, this approach aligns well with adult learning theories and current nursing education reform priorities.

However, not all studies universally endorse the flipped model. Moffett et al. (2020), for instance, found no significant difference in anatomy exam scores between students taught through flipped and traditional models, suggesting that contextual factors such as content quality, instructional design, and learner readiness can influence effectiveness. Likewise, McLaughlin et al. (2023) cautioned that flipped learning may inadvertently disadvantage students lacking digital access or technological fluency highlighting the importance of equitable infrastructure and learner support.

Despite such caveats, the cumulative evidence, including findings from this study, supports the adoption of flipped learning as a transformative instructional strategy in anatomy education, especially in low-resource settings. The significant gains observed among students at the University of Kabianga indicate that, with intentional planning and adequate support, flipped learning can bridge gaps in understanding, foster meaningful engagement, and ultimately enhance learner success. Future research should investigate long-term knowledge retention, the impact on clinical skill application, and broader student experiences to further refine the model's implementation within nursing curricula.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study concludes that the flipped classroom model, which utilized lecturer-generated YouTube videos shared via WhatsApp followed by interactive face-to-face sessions, significantly improved anatomy knowledge among first-year BSc Nursing students at the University of Kabianga. The model not only fostered active learning and improved comprehension but also demonstrated feasibility and scalability in a resource-constrained academic environment. By enabling students to learn at their own pace and come to class prepared for application-based learning, the flipped approach aligns well with competency-based education and adult learning principles, making it a valuable pedagogical tool in nursing education.

Recommendations

Based on these findings, several recommendations are proposed. First, nursing curriculum committees should consider integrating the flipped classroom model into foundational courses such as anatomy to promote deeper engagement and improved academic outcomes. Second, faculty should be supported and trained in creating short, focused micro-learning content suitable for digital dissemination, thereby enhancing blended delivery strategies. Lastly, future research should include intervention studies with control groups and follow-up assessments to evaluate long-term retention and the applicability of flipped learning across other core nursing subjects.

Limitations

This study was limited by its quasi-experimental design without a control group, which may limit causal inference. Additionally, the study involved a small sample from a single institution, which may affect generalizability. Long-term retention of knowledge was not assessed due to calendar constraints. However, future studies should include control groups, larger multi-site samples, and longitudinal follow-up assessments to evaluate retention and clinical application of knowledge.

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APPENDICES

Appendix I: Informed Consent Form

Title of the Study: *Effectiveness of a Flipped Classroom Approach Using YouTube and WhatsApp in Teaching Anatomy to First-Year Nursing Students at the University of Kabianga*

Investigator: Thomas Ng'ambwa, Department of Nursing, University of Kabianga

Purpose of the Study: This study aims to evaluate the effectiveness of using a flipped classroom approach in teaching anatomy, whereby students view YouTube videos before attending interactive sessions.

Procedures:
Participants will be required to:

- Watch lecturer-generated YouTube videos sent via WhatsApp
- Attend follow-up face-to-face discussion sessions
- Complete a short pretest and posttest
- Fill a brief feedback questionnaire

Voluntary Participation and Confidentiality: Participation is entirely voluntary, and you may withdraw at any time without penalty. Your responses will remain confidential and used for academic purposes only.

Benefits: You may benefit from improved understanding of anatomy, better test performance, and contribute to educational research that may benefit future students.

Risks: There are minimal risks involved in this study. Data will be anonymized.

Consent Statement: I have read and understood the information above. I voluntarily agree to participate in this study.

Name of Participant: _____ Signature: _____Date: _____

Appendix II: Student Feedback Questionnaire *(Adapted from Khanova et al., 2020)*

Please rate the following items based on your experience with the flipped classroom approach (1 = Strongly Disagree, 5 = Strongly Agree).

Statement	**1**	**2**	**3**	**4**	**5**
1. The videos helped me understand anatomy concepts better.					
2. Watching videos before class prepared me for in-class activities.					
3. The WhatsApp platform was effective for receiving learning materials.					
4. I found in-person sessions more engaging after watching the videos.					
5. I would recommend this learning approach for future classes.					

Open-ended Questions:

1. What did you like most about the flipped classroom approach?
2. What challenges did you experience?
3. Suggestions for improvement:

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume IX Issue IIIS July 2025 | Special Issue on Education

Appendix III: Pretest and Posttest Score Sheet

This score sheet was used to track individual student performance before and after the flipped classroom intervention.

Student ID	Pretest Score (CAT 1) (%)	Posttest Score (CAT 2) (%)	Difference (%)	Improved? (Yes/No)	Remarks
001					
002					
003					
004					
005					
…					
064					