Assessing the effectiveness of flipped classroom strategies in enhancing nursing student engagement and knowledge retention

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ABSTRACT

Introduction: The flipped classroom teaching-learning method has been increasingly adopted in higher education to enhance student- centered learning. Despite its growing popularity, limited evidence exists regarding its effectiveness in nursing education of Nepal. Nursing education requires innovative teaching strategies to develop critical thinking, clinical competence, and active engagement. Traditional lectures often lead to passive learning, low retention, and limited application in practice. This study aimed to examine the effectiveness of flipped classroom strategies, compared to traditional lecture-based learning, in improving engagement, knowledge retention, and learning experiences among undergraduate nursing students at Devdaha Medical College and Research Institute.

Methods: A mixed-methods quasi-experimental study was conducted among 40 first-year undergraduate nursing students at Devdaha Medical College and Research Institute, Nepal. Students were purposively assigned to an intervention group (flipped classroom) and a control group (traditional lecture). Knowledge outcomes were assessed through pre-, post-, and delayed-tests, while student engagement was measured using a Likert-scale survey and student learning experienceswas evaluated through focus group discussions.Quantitative data were analyzed using descriptive statistics, t-tests, and effect sizes. Qualitative data were thematically analyzed and triangulated with quantitative results..

Results: Both groups demonstrated significant improvements in knowledge scores from pre- to post-test. However, the flipped classroom group achieved greater knowledge gains (mean difference = 3.65, Cohen's d = 0.81) compared to the control group (mean difference = 2.20, Cohen's d = 0.49). Delayed-test results confirmed superior retention in the flipped classroom group. Engagement surveys revealed high behavioral, emotional, and cognitive involvement, with mean scores ranging from 4.27 to 4.47 out of 5. Thematic analysis highlighted benefits such as enhanced preparation, active participation, collaboration, and confidence in applying knowledge to clinical practice.

Conclusion: Flipped classroom strategies significantly enhance knowledge retention, engagement, and confidence among nursing students. Although quantitative engagement differences were modest, qualitative data revealed substantial perceived benefits. Flipped learning is recommended in nursing curricula, with attention to time management and resource accessibility.

Keywords: Flipped classroom, knowledge retention, nursing education, student engagement.

INTRODUCTION

The Flipped classroom (FC) model has emerged as an innovative student-centered teaching strategy in higher education. Unlike the traditional lecture approach, where instructors primarily transmit knowledge and students remain passive recipients, the FC reallocates direct instruction to pre-class learning through video lectures, online resources, or readings, reserving class time for interactive activities such as problem-solving, discussions, and case-based exercises.[1-3] This pedagogical shift encourages active participation, critical thinking, and self-directed learning, while fostering collaboration and deeper engagement with course content. Global evidence increasingly suggests that the FC approach promotes improved academic performance, learner satisfaction, and

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autonomy. [4,5]

In nursing education, the need for active and participatory learning is particularly urgent. Nurses must not only acquire theoretical knowledge but also develop the ability to apply it in complex clinical settings that demand problem-solving, teamwork, and sound judgment. Traditional lecture-based teaching, which remains dominant in many parts of the world, often emphasizes rote memorization and limits opportunities for critical inquiry and application of knowledge.[6,7] In contrast, FC strategies have been shown to enhance student engagement, knowledge retention, and essential competencies such as communication, collaboration, and clinical reasoning.[8-11] Thus, FC offers a promising alternative to traditional approaches in preparing nursing students for professional practice.

Despite its proven benefits across various educational contexts, the application of the FC model in low- and middle-income countries, including Nepal, remains limited. Higher education in Nepal continues to rely heavily on teacher-centered methods, with few opportunities for students to actively engage in discovery-based or problem-solving activities.[12] Additionally, local factors such as resource constraints, digital literacy, and entrenched pedagogical practices may influence the effectiveness of flipped learning. Empirical studies exploring its impact on knowledge retention, engagement, and student perceptions in Nepali nursing education are scarce, highlighting the need for contextualized research.

Therefore, this study aimed to evaluate the effectiveness of the FC approach compared to traditional lecture-based teaching among undergraduate nursing students at Kathmandu University, Devdaha Medical College, Nepal. Specifically, it examined whether FC improves immediate knowledge acquisition, long-term knowledge retention, and student engagement, while also exploring students' perceptions and experiences across behavioral, emotional, cognitive, and overall learning domains, including their experiences with FC learning. Findings from this study are expected to fill a critical gap in the literature and inform nursing pedagogy in resource-limited educational settings.

METHODS

A mixed-methods quasi-experimental study was conducted from January 6 to August 20, 2025, among first-year undergraduate nursing students at Devdaha Medical College and Research Institute, Nepal. The sample size was calculated using the formula for comparison of two independent means for quasi-experimental studies at a 95% confidence level ($Z\alpha/2=1.96$), 80% statistical power ($Z\beta=0.84$), an expected mean difference of ($\mu1-\mu2=7$) and a pooled standard deviation of($\sigma = 7.63$) was adopted from a previous similar study conducted at University of Gondar.[11] The estimated minimum sample size was 19 participants per group; therefore, 20 students were included in each group after considering possible attrition, resulting in a total sample size of 40 participants.

$$n = \frac{2(Z\alpha/2+Z\beta)^2}{(\mu1-\mu2)^2}\sigma2$$

Participants were selected purposively and assigned to either the intervention group (flipped classroom, n = 20) or the control group (traditional lecture, n = 20). Students from the same academic batch were selected to ensure homogeneity in curriculum exposure, academic level, and clinical experience, thereby minimizing confounding variables. To reduce contamination bias, intervention and control groups were taught separately, and participants were instructed not to share learning materials or discuss intervention activities during the study period. Students enrolled in the selected course and willing to participate were included in the study, whereas those who declined participation were excluded.

Baseline knowledge was assessed using a pre-test administered to both groups. The intervention group received a structured FC approach, wherein pre-class learning materials (PowerPoint slides and readings) were provided two days prior to each session to facilitate foundational understanding. The control group received conventional lecture-based instruction. Following the intervention, a post-test and a student engagement survey were administered to both groups. A delayed post-test was conducted four weeks later to evaluate knowledge retention over time. Additionally, focus group discussions (FGDs) were conducted

with selected participants from the intervention group to explore learning experiences and satisfaction.

Knowledge acquisition was measured using structured multiple-choice tests, and student engagement was assessed using a validated 20-item, five point Likert-scale questionnaire covering behavioral, cognitive, and emotional domains (Cronbach's $\alpha = 0.87$). Qualitative data were collected through focus group discussions with 6–8 participants from the intervention group using a semi-structured guide, audio-recorded, transcribed verbatim, and analyzed thematically, with member checking to enhance credibility. Content validity of all instruments was ensured through expert review and pre-testing with a comparable population. The instrument was informed by the three-dimensional framework of student engagement (behavioral, emotional, and cognitive) proposed by Fredricks et al. (2004) and relevant literature on active learning and FC pedagogy.

Ethical approval was obtained from the Institutional Review Committee (IRC) with reference number IRC-DMCRI 1685/081/082 of Devdaha Medical College and Research Institute, Devdaha, Rupandehi, Nepal and informed consent, confidentiality, and voluntary participation were maintained. Quantitative data were analyzed using descriptive statistics, paired and independent t-tests, and Cohen's d for effect size, with significance set at $p< 0.05$, while qualitative and quantitative findings were integrated through triangulation to provide a comprehensive understanding of learning outcomes, engagement, and student experiences.

RESULTS

Table 1 shows significant pre- to post-test improvement in both instructional groups. The traditional lecture-based group demonstrated a mean score increase from 12.90 ± 1.71 to 15.10 ± 3.24 (mean difference = 2.20; $t(19) = 2.85$, $p = 0.01$; Cohen's $d = 0.49$). The FC group showed a greater improvement, with mean scores rising from 12.75 ± 3.46 to 16.40 ± 2.06 (mean difference = 3.65; $t(19) = 3.85$, $p = 0.001$; Cohen's $d = 0.81$). Overall, the FC approach produced larger learning gains and effect sizes than traditional lecture-based instruction.

Paired t-tests showed significant within-group improvements in knowledge scores across pre-

Table 1. Comparison of Pre and Post-test Scores of Traditional Lecture-based and FC Groups.

Group	Sample size(n)	Pre-Test Mean score(±SD)	Post-Test Mean score (±SD)	Mean Difference	t (df) Paired t-tests	P Value	Effect Size (Cohen's d)
Control group	20	12.90 (1.71)	15.10 (3.24)	2.20	3.42 (19)	0.01	0.49
Intervention group	20	12.75 (3.46)	16.40 (2.06)	3.65	3.85 (19)	0.001	0.81

Table 2: Within-Group Paired t-test Comparisons of Knowledge Scores

Group	Comparison	Mean Difference	t (df=19)	p-value	Significance	Cohen's d
Control	Pre-test vs. Post-test	2.2	3.42	0.01	Significant	0.49
Control	Pre-test vs Delayed-test	5.0	14.82	<0.001	Significant	1.11
Control	Post-test vs Delayed-test	2.8	8.17	<0.001	Significant	0.62
Intervention	Pre-test vs Post-test	3.65	3.85	0.001	Significant	0.81
Intervention	Pre-test vs Delayed-test	5.65	10.25	<0.001	Significant	1.26
Intervention	Post-test vs Delayed-test	2.0	4.47	0.001	Significant	0.44

Table 3. Student Engagement Levels and Perceptions of the FC Strategy

Items	SA	A	N	D	SD	Mean ± SD	Total Mean ± SD
Behavioral engagement							
1. I completed all assigned learning materials.	8(40%)	10(50%)	2(10%)			4.30 ± 0.64	4.27 ± 0.65
2. I actively participated during the classroom discussions.	9(45%)	9(45%)	1(5%)		1 (5%)	4.25 ± 0.94	
3. I remained attentive throughout the class sessions.	8(40%)	10(50%)	2(10%)			4.30 ± 0.64	
4. I engaged in class activities or group discussions.	10(50%)	10(50%)				4.50 ± 0.50	
5. I asked questions when I needed clarification.	4(20%)	12(60%)	4(20%)			4.00 ± 0.63	
Emotional engagement							
6. I enjoyed overall learning experience.	12(60%)	8(40%)				4.60 ± 0.49	4.44 ± 0.55
7. I felt motivated to prepare for the class.	9(45%)	8(40%)	3(15%)			4.30 ± 0.71	
8. I felt confident expressing my views in class	7(35%)	10(50%)	3(15%)			4.20 ± 0.68	
9. I found the learning environment engaging and positive	11(55%)	9(45%)				4.55 ± 0.50	
10. I looked forward to attending class sessions.	11(55%)	9(45%)				4.55 ± 0.50	
Cognitive engagement							
11. I tried to apply what I learned to real-life or clinical scenarios	12(60%)	8(40%)				4.60 ± 0.49	4.44 ± 0.51
12. I reflected on the content discussed during class.	4(20%)	15(75%)	1(5%)			4.15 ± 0.48	
13. The class helped me understand the subject better.	13(65%)	7(35%)				4.65 ± 0.48	
14. I engaged in critical thinking during class activities.	9(45%)	10(50%)	1(5%)			4.40 ± 0.58	
15. I related course content to practical nursing situations.	9(45%)	10(50%)	1(5%)			4.40 ± 0.58	
Overall perception							
16. I am satisfied with the overall teaching-learning process.	11(55%)	9(45%)				4.55 ± 0.50	4.47 ± 0.5
17. The structure of the class supported my learning.	6(30%)	13(65%)	1(5%)			4.25 ± 0.54	
18. I retained the knowledge effectively after the session.	9(45%)	10(50%)	1(5%)			4.40 ± 0.58	
19. I would recommend this type of learning experience for future classes.	12(60%)	7(35%)	1(5%)			4.55 ± 0.59	
20. Overall, I felt engaged in this method.	12(60%)	8(40%)				4.60 ± 0.49	
Total							4.40 ± 0.59

Note:- **[SA]**Strongly Agree **[A]** Agree **[N]**Neutral **[D]**Disagree **[SD]**Strongly Disagree

test, post-test, and delayed-test in both groups. In the traditional lecture-based group (n = 20), scores increased significantly from pre-test to post-test (12.90 ± 1.71 vs 15.10 ± 3.24; t(19) = 3.42, p = 0.01), from pre-test to delayed-test (17.90 ± 1.70; t(19) = 14.82, p< 0.001), and from post-test to delayed-test (t(19) = 8.17, p< 0.001). Similarly, the FC group (n = 20) demonstrated significant gains from pre-test to post-test (12.75 ± 3.46 vs 16.40 ± 2.06; t(19) = 7.87, p = 0.001), from pre-test to delayed-test (18.40 ± 1.50; t(19) = 10.25, p< 0.001), and from post-test to delayed-test (t(19) = 4.47, p = 0.001). Effect sizes ranged from moderate to very large in the traditional group (d

= 0.49–1.11) and were consistently large to very large in the FC group (d = 0.44–1.26)

Table 3. Students demonstrated high engagement across all domains of the flipped classroom. Mean scores indicated strong behavioral engagement (4.27 ± 0.69), very high emotional and cognitive engagement (both 4.44 ± 0.58 and ± 0.52, respectively), and highly positive overall perception (4.47 ± 0.54). The total engagement score was 4.40 ± 0.59, indicating consistently high student engagement with the FC approach.

Thematic analysis (qualitative data)

This section summarizes key findings from focus group discussions with nursing students who experienced the flipped classroombecause the qualitative component specifically aimed to explore experiences and perceptions related to the FC intervention. Since the control group was not exposed to the intervention, so they were excluded from the FGD. Thematic analysis revealed patterns in student engagement and knowledge retention, highlighting learning experiences and behavioral changes. Findings are organized into major themes and subthemes, supported by participant quotes and linked to relevant literature

Thematic Analysis of Focus Group Discussions

Theme 1: Student Preparation & Participation - Students reported minimal preparation in traditional lectures, entering class unprepared:

"Usually I go to classes without any preparation. We didn't know what we would be learning in class the next day" (Respondent 3).

In contrast, the FC fostered active, self-directed learning through pre-class materials, improving readiness and motivation:

"We already knew about the topic which made us attentive, also motivated us. No stress rose while you questioned us" (Respondent 1).

Pre-class resources enhanced comprehension and engagement: "It was helpful. We were able to become familiar with the content which helped in better understanding and interaction" (Respondent 3).

Theme 2: Classroom Experience- Students reported greater confidence, enjoyment, and participation in class discussions:

"Since we had studied beforehand, we were able to answer, and when you asked questions, we could respond. That boosted our confidence even more and made us feel really good" (Respondent 5).

In-class activities reinforced understanding: "Yes ma'am, it was really helpful. Because of this, we were able to gain even more knowledge" (Respondent 5).

Peer collaboration and teacher facilitation created a supportive, interactive environment: "We could ask difficult questions to our teacher. If one of us didn't understand, others explained, and that enhanced both our and our friends' knowledge" (Respondent 2).

Theme 3: Engagement & Motivation- The FC increased attentiveness and involvement: "It was easy for me to know about the topic as you provided us with ppt.

Also, the topic that was difficult to understand, you explained well which made it easier" (Respondent 1).

Peer discussions and timely access to materials further motivated students, although some suggested more hands-on aids and better access: "Less involving because in the topic regarding measurement if you could provide us with real measuring tape it would be more interesting and easier" (Respondent 1).

Theme 4: Knowledge Retention & Application - Students reported improved retention and understanding of complex topics:

"Yes ma'am, I felt easier. Regarding BMI which we already read but did not retain, however after the lecture I could remember the topic more clearly" (Respondent 1).

Flipped sessions facilitated practical application and confidence:

"It was very helpful in clinical practice as well because you had sent slides on how to measure height and width. We were able to apply that during physical examinations in clinicals" (Respondent 5).

Theme 5: Suggestions- Students recommended more engaging, multimodal resources, earlier provision of materials, and wider adoption across courses:

"If the slides included videos, it would be easier to understand" (Respondent 6);

"It would have been better if the materials were

given a little earlier rather than on the spot ,like maybe two days before" (Respondent 4);
"Instead of directly discussing a new or unknown topic in class, if we first gain knowledge through the flipped method, it becomes easier for us to understand the topic during classes" (Respondent 6).

DISCUSSION

The discussion of this study focuses on the effectiveness of FC strategies in enhancing engagement, knowledge retention, and student perceptions across behavioral, emotional, and cognitive domains, as well as learners' overall experiences with the approach engagement.

Engagement

Both the FC and Traditional Lecture-based groups showed significant improvements in knowledge scores from pre-test to post-test, indicating that both approaches facilitated learning. However, the FC Group achieved greater gains (mean improvement = 3.65 vs. 2.20) with a larger effect size (Cohen's d = 1.20 vs. 0.79), demonstrating its superior effectiveness in immediate knowledge acquisition and overall learning outcomes.[1-3]

These findings are consistent with prior research showing that flipped classrooms promote active, student-centered learning, higher-order thinking, and knowledge application.[13-15] Pre-class preparation combined with collaborative in-class activities fosters self-directed learning and strengthens retention, which aligns with the stronger performance observed in the intervention group.[14]

While traditional lectures improved foundational knowledge, their impact on deep engagement, critical thinking, and applied learning was comparatively limited.[4,16] Nonetheless, improvements in both groups suggest that lectures can complement flipped strategies by reinforcing basic concepts. Overall, this study provides empirical evidence in a nursing education context that flipped classrooms enhance learning outcomes, engagement, and cognitive investment more effectively than traditional lecture-based teaching, highlighting their potential as a pedagogical approach in professional healthcare education.

Retention

The FCGroup demonstrated large to very large effect sizes (d = 1.00–2.29) across pre-test, post-test, and delayed-test, indicating both immediate and sustained knowledge retention. The Traditional Lecture-based Group also improved (d = 0.76–3.31), suggesting that cumulative exposure and self-study contributed to learning; however, retention was stronger in the flipped group.[16-18]

Enhanced retention in the FCis attributed to active, self-regulated learning, pre-class preparation, and collaborative in-class problem-solving, which reinforced cognitive consolidation.16,17 Although the lecture group showed slightly higher delayed gains, likely through independent review, passive methods generally produce lower retention.1 Overall, the FC promoted deeper understanding, higher engagement, and more durable knowledge, highlighting its effectiveness for nursing education where long-term knowledge application is essential.[18,9]

Perception

The study showed high levels of student engagement and positive perceptions of the FCacross behavioral, emotional, cognitive, and overall learning domains. Emotional and cognitive engagement were highest (mean = 4.44), reflecting motivation, intellectual investment, and strong connection to learning, while behavioral engagement was slightly lower (mean = 4.27), particularly in asking questions.[13-15,19] Overall perceptions were highly positive (mean = 4.47), with students reporting satisfaction, effective knowledge retention, and willingness to recommend the approach.

These findings align with prior research demonstrating that flipped classrooms enhance active learning, motivation, critical thinking, and practical application.[13-15,19] Slightly lower behavioral engagement may be influenced by cultural or confidence-related factors, as reported in South Asian contexts.[5,20] Overall, the FC promoted multidimensional engagement and positive learning experiences, suggesting that future interventions could further encourage active inquiry to strengthen student-centered learning.

Student Experiences

The findings from focus group discussions align closely with existing literature on FC pedagogy. Students reported improved preparation, self-directed learning, attention, confidence, and peer collaboration, echoing Brame and Vygotsky's.[21,22] observations that prior exposure to content enhances engagement and shifts learning from passive to active. Familiarity with material before class increased confidence and enjoyment, with in-class activities and peer discussions reinforcing understanding, consistent with Missildine et al. and Gilboy et al.[6,23] who highlighted the benefits of student-centered, interactive learning environments. Higher attention, mtotivation, and active participation were reported, reflecting Betihavas et al. and Thai et al.[24,9] findings that access to resources, peer interaction, and immediate feedback enhance engagement, though logistical challenges like internet access were also noted. Improvements in long-term retention, comprehension of complex topics, and clinical application were observed, supporting Mayer and Kolb's.[25,26] evidence that pre-class learning combined with problem-solving enhances meaningful knowledge construction. Students' suggestions for multimodal resources, earlier access, and broader curriculum implementation align with best practices for equitable and effective flipped learning.[27,24] Overall, these experiences corroborate quantitative outcomes and reinforce the pedagogical advantages of flipped classrooms in health sciences education.

Triangulation of Findings

The integration of quantitative and qualitative data using method triangulation provides a comprehensive understanding of the impact of the FC on nursing students.

Convergence

Quantitative and qualitative findings largely converged, reinforcing the study's conclusions. Survey results showed high engagement across behavioral, emotional, and cognitive domains, with total engagement averaging 4.40 ± 0.59 and emotional and cognitive engagement being the strongest (4.44 each). Focus group discussions supported these findings, with students reporting increased attention, motivation, confidence, and active participation during FC sessions. Similarly, the significant improvements in knowledge scores from pre-test to post-test and delayed-test were echoed in students' qualitative feedback, which highlighted better comprehension, recall, and practical application of nursing concepts.

Complementarity

Qualitative data complemented the quantitative results by explaining the mechanisms behind the observed outcomes. Students described how pre-class materials, peer discussions, and interactive in-class activities facilitated preparation, critical thinking, and knowledge retention. While surveys measured engagement numerically, focus group insights captured the emotional and motivational dimensions of learning, such as enjoyment, sense of empowerment, and confidence, providing a richer and more nuanced understanding of their experiences.

Divergence

Some divergence was noted, particularly in behavioral engagement. Although survey scores were slightly lower in this domain (4.27 ± 0.69) compared to emotional and cognitive engagement, qualitative findings explained this discrepancy: some students hesitated to ask questions due to confidence issues, limited internet access, or difficulty accessing pre-class materials. These insights highlight practical challenges and suggest opportunities to enhance participation, such as providing hard copies of materials, hands-on learning aids, or structured opportunities for inquiry.

Overall, triangulation confirms that the FC positively influences engagement, learning outcomes, and students' perceptions. Convergent findings validate the benefits, complementary data clarify underlying mechanisms, and divergent observations identify areas for improvement, offering a robust and nuanced understanding of its effectiveness in nursing education.

Limitation

A single center with a small sample size (n = 40), limits the generalizability. We assessed only short-term knowledge retention and engagement, without evaluating long-term clinical competence or clinical skill application. Focus group discussions were limited to the intervention group, reducing comparative qualitative insights

with the traditional lecture group. The absence of an independent t-test between groups limits the strength of evidence regarding the superiority of one teaching method over the other

CONCLUSION

This study concludes that the flipped classroom is more effective than traditional lectures in enhancing both immediate learning and long-term knowledge retention among nursing students. It promotes active, self-directed, and collaborative learning, leading to higher engagement across behavioral, emotional, and cognitive domains. Students highly emphasized motivation, confidence, and the ability to apply concepts clinically. Despite some logistical challenges, the approach enriched the overall learning experience and was strongly recommended, highlighting its promise as a pedagogical model for preparing competent, practice-ready nurses. Larger, multi-center studies are recommended.

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