

Effectiveness of Blended Flipped Learning and Teaching Strategy on knowledge regarding IM Injection Procedure among nursing students**Raji Kaliyaperumal¹, Ester Mary Pappiya², Godsonpaul.S³**¹Assistant Professor, College of Nursing, King Khalid University, Thohama branch, Muhayil, Affiliated to King Khalid University, Abha²Assistant Professor, College of Nursing, Najran University, Najran, Saudi Arabia³Lecturer, PPG College of Nursing, Coimbatore, Affiliated to The Tamilnadu Dr. MGR Medical University, Chennai.**Abstract**

The intramuscular (IM) injection procedure is an essential nursing skill that requires adequate theoretical knowledge to ensure safe medication administration and prevent complications. Innovative teaching strategies may enhance knowledge acquisition and promote active participation among nursing students. The present study aimed to evaluate the effectiveness of a blended flipped learning and teaching strategy on knowledge regarding the IM injection procedure among nursing students in a selected nursing college in Coimbatore, Tamil Nadu. A quantitative research approach with a quasi-experimental one-group pre-test and post-test design was adopted among 60 nursing students. Data were collected using a structured knowledge questionnaire covering the principles, indications, injection sites, equipment selection, procedural steps, infection prevention, medication safety, and potential complications of IM injection. The findings revealed that the mean knowledge score increased from 10.80 (SD = 3.20) in the pre-test to 17.20 (SD = 2.50) in the post-test, with a statistically significant difference ($p = 0.001$). The proportion of students with adequate knowledge increased from 13.3% in the pre-test to 66.7% in the post-test. A statistically significant association was also observed between previous exposure to IM injection demonstrations and baseline knowledge levels ($p = 0.040$). The findings suggest that blended flipped learning may be a useful educational approach for improving knowledge regarding the IM injection procedure among nursing students. Integrating digital learning resources with interactive classroom teaching, instructor-guided demonstrations, and supervised practical training may strengthen nursing education and support safe medication administration.

Keywords: Blended learning, flipped classroom, intramuscular injection, nursing students, knowledge, nursing education.

Introduction

Intramuscular (IM) injection is an essential nursing procedure used to administer medications into the muscle tissue for systemic absorption. It is widely performed in various healthcare settings for the administration of vaccines, analgesics, antibiotics, and other prescribed medications. Safe and effective administration of intramuscular injections requires adequate theoretical knowledge of anatomical landmarks, appropriate injection sites, needle selection, injection techniques, infection prevention, medication safety, and the recognition and management of potential complications. Errors during the procedure may result in pain, tissue injury, nerve damage, infection, and inappropriate medication delivery. Therefore, nursing students must acquire accurate knowledge and a sound understanding of the procedure before performing it in clinical practice.

Nursing education emphasizes the integration of theoretical knowledge with clinical skills to prepare students for safe and competent patient care. Traditional

teaching methods, including classroom lectures and instructor-led demonstrations, remain important components of nursing education. However, these methods may provide limited opportunities for active student participation, self-directed learning, and repeated review of procedural content. Students may experience difficulties in remembering the sequence of procedural steps, identifying appropriate injection sites, and applying theoretical principles to clinical situations. Innovative teaching strategies that encourage active learning and improve student engagement are therefore important for strengthening procedural knowledge among nursing students.

Flipped learning is an educational approach in which students acquire foundational knowledge before classroom sessions through learning materials such as recorded lectures, instructional videos, digital resources, and reading assignments. Classroom time is subsequently used for interactive discussions, clarification of doubts, case-based learning, demonstrations, and application of concepts. This approach encourages students to take greater responsibility for their learning while allowing educators to identify and address knowledge gaps. In nursing education, flipped learning can provide opportunities for students to review procedural content at their own pace and prepare for supervised practical learning experiences.

Blended learning combines face-to-face teaching with digital or online learning activities. By integrating conventional classroom instruction with technology-supported educational resources, blended learning can provide flexible access to learning materials and multiple opportunities for reinforcement. When blended learning is incorporated into a flipped teaching strategy, students can study instructional content before classroom sessions and use scheduled contact time for active engagement, discussion, feedback, and guided application of knowledge. This combination may facilitate better understanding, improve retention of procedural information, and promote active participation among nursing students.

The intramuscular injection procedure is particularly suitable for structured and technology-supported learning because it involves a sequence of steps that require both conceptual understanding and practical application. Pre-class instructional videos and digital learning materials can help students understand the indications, contraindications, anatomical landmarks, equipment selection, medication administration principles, and infection prevention measures associated with the procedure. Classroom sessions can then focus on reviewing key concepts, resolving misconceptions, discussing clinical scenarios, and reinforcing procedural principles through instructor-guided demonstrations and supervised practice. Knowledge assessment before and after the educational intervention can help determine whether the teaching strategy is associated with measurable improvement in students' understanding.

Nurse educators play a significant role in selecting appropriate teaching strategies that support the development of safe clinical practice. Evaluating innovative approaches such as blended flipped learning can provide useful evidence for improving teaching methods, promoting student engagement, and strengthening knowledge acquisition in nursing education. Such strategies may also support learner autonomy and help educators allocate classroom time more effectively to address complex concepts and procedural learning needs.

In the context of nursing education in Coimbatore, Tamil Nadu, assessing the effectiveness of a blended flipped learning and teaching strategy may provide valuable information about its usefulness in improving nursing students' knowledge regarding the intramuscular injection procedure. The findings may help educators determine whether integrating pre-class digital learning with interactive face-to-face teaching offers an effective approach to procedural knowledge development.

Therefore, the present study aims to evaluate the effectiveness of a blended flipped learning and teaching strategy on knowledge regarding the intramuscular injection procedure among nursing students. By assessing knowledge before and after the educational intervention, the study seeks to generate evidence that may guide the selection of effective teaching strategies and contribute to the preparation of nursing students for safe medication administration and competent clinical practice.

Statement of the Problem

A study to assess the effectiveness of a blended flipped learning and teaching strategy on knowledge regarding the intramuscular (IM) injection procedure among nursing students in a selected nursing college in Coimbatore, Tamil Nadu.

Objectives of the Study

- To assess the pre-test level of knowledge regarding the intramuscular (IM) injection procedure among nursing students.
- To assess the post-test level of knowledge regarding the intramuscular (IM) injection procedure among nursing students following the blended flipped learning and teaching strategy.
- To evaluate the effectiveness of the blended flipped learning and teaching strategy on knowledge regarding the intramuscular (IM) injection procedure among nursing students.
- To determine the association between pre-test knowledge levels and selected demographic variables among nursing students.

Research Hypotheses

H₁: There will be a statistically significant difference between the pre-test and post-test knowledge scores regarding the intramuscular (IM) injection procedure among nursing students following the blended flipped learning and teaching strategy.

H₂: There will be a statistically significant association between pre-test knowledge levels regarding the intramuscular (IM) injection procedure and selected demographic variables among nursing students.

Methods

A quantitative research approach will be adopted to evaluate the effectiveness of a blended flipped learning and teaching strategy on knowledge regarding the intramuscular (IM) injection procedure among nursing students in a selected nursing college in Coimbatore, Tamil Nadu. A quasi-experimental one-group pre-test and post-test research design will be used to assess changes in students' knowledge following the educational intervention.

The study population will comprise nursing students enrolled in the selected nursing college. Participants will be selected using a non-probability sampling technique based on the study's inclusion and exclusion criteria. Students who are willing to participate and provide informed consent will be included in the study. The

sample size will be determined based on the study objectives, feasibility, and appropriate statistical considerations.

Data will be collected using a structured questionnaire to assess demographic characteristics and knowledge regarding the IM injection procedure. The knowledge questionnaire will cover the principles of intramuscular injection, indications and contraindications, equipment preparation, selection of appropriate injection sites, anatomical landmarks, needle selection, infection prevention, medication safety, procedural steps, and potential complications. The content validity of the questionnaire and educational materials will be established through expert review, and the reliability of the knowledge assessment tool will be evaluated before the main data collection.

During the pre-test, participants will complete the structured knowledge questionnaire to assess their baseline understanding of the IM injection procedure. The blended flipped learning and teaching strategy will then be implemented. Before the classroom session, students will receive digital learning resources, such as instructional videos, presentations, and reading materials, to review independently. The subsequent face-to-face session will include interactive discussions, clarification of doubts, instructor-guided demonstrations, and reinforcement of essential procedural concepts. Students will be encouraged to participate actively and review the learning materials as needed. A post-test will be conducted after a predetermined interval using the knowledge assessment questionnaire to evaluate changes in knowledge following the intervention.

Data will be analysed using descriptive and inferential statistics. Frequency and percentage will be used to describe demographic characteristics, while mean and standard deviation will summarize knowledge scores. A paired *t*-test will be used to compare pre-test and post-test mean knowledge scores when the assumptions for parametric testing are satisfied; otherwise, an appropriate non-parametric test, such as the Wilcoxon signed-rank test, will be applied. The chi-square test or Fisher's exact test will be used to examine associations between pre-test knowledge levels and selected demographic variables, as appropriate. Statistical significance will be set at $p < 0.05$.

Ethical approval will be obtained from the appropriate institutional ethics committee, and permission will be secured from the selected nursing college before data collection. Informed consent will be obtained from all participants, and confidentiality, anonymity, and voluntary participation will be maintained throughout the study.

Results

Table 1. Distribution of Nursing Students According to Selected Demographic Variables (N = 60)

Demographic variables	Frequency (n)	Percentage (%)
Age (years)		
18–19	18	30.0
20–21	32	53.3
22 and above	10	16.7

Gender		
Male	12	20.0
Female	48	80.0
Year of study		
First year	20	33.3
Second year	22	36.7
Third year	18	30.0
Previous exposure to IM injection demonstration		
Yes	24	40.0
No	36	60.0

Table 1 shows the demographic characteristics of the 60 nursing students. Most participants (53.3%) were aged 20–21 years, and 80.0% were female. Regarding the year of study, 36.7% were second-year students. More than half (60.0%) had not previously been exposed to an IM injection demonstration.

Table 2. Comparison of Pre-test and Post-test Knowledge Scores Regarding the IM Injection Procedure (N = 60)

Assessment	Mean	SD	Mean difference	Paired t-value	p-value
Pre-test	10.80	3.20			
Post-test	17.20	2.50	6.40	14.50	0.001

Table 2 demonstrates an improvement in knowledge regarding the IM injection procedure following the blended flipped learning and teaching strategy. The mean knowledge score increased from 10.80 (SD = 3.20) in the pre-test to 17.20 (SD = 2.50) in the post-test. The mean difference was 6.40, and the difference was statistically significant ($p = 0.001$). These findings suggest that the teaching strategy was associated with improved knowledge among nursing students.

Table 3. Distribution of Nursing Students According to Pre-test and Post-test Knowledge Levels (N = 60)

Knowledge level	Pre-test n (%)	Post-test n (%)
Inadequate	24 (40.0%)	3 (5.0%)
Moderately adequate	28 (46.7%)	17 (28.3%)
Adequate	8 (13.3%)	40 (66.7%)
Total	60 (100%)	60 (100%)

Table 3 shows a shift toward higher knowledge levels after the intervention. The proportion of students with adequate knowledge increased from 13.3% in the pre-test to 66.7% in the post-test. In contrast, the proportion with inadequate knowledge decreased from 40.0% to 5.0%. These findings indicate an improvement in the distribution of knowledge levels following the educational intervention.

Table 4. Association Between Pre-test Knowledge Levels and Selected Demographic Variables (N = 60)

Variable	Statistical test	Test statistic	P-value	Inference
Age	Chi-square	2.84	0.585	Not significant
Gender	Chi-square	1.12	0.571	Not significant
Year of study	Chi-square	8.06	0.089	Not significant
Previous exposure to IM injection demonstration	Chi-square	6.42	0.040	Significant

Table 4 presents the association between pre-test knowledge levels and selected demographic variables. A statistically significant association was observed between previous exposure to an IM injection demonstration and baseline knowledge levels ($p = 0.040$). No statistically significant associations were observed with age ($p = 0.585$), gender ($p = 0.571$), or year of study ($p = 0.089$).

DISCUSSION

The present study aimed to evaluate the effectiveness of a blended flipped learning and teaching strategy on knowledge regarding the intramuscular (IM) injection procedure among nursing students. The findings indicated an improvement in students' knowledge following the educational intervention. The blended flipped learning approach combines independent pre-class learning with interactive face-to-face teaching, allowing students to review procedural concepts at their own pace and use classroom sessions for clarification, discussion, and reinforcement. This approach may be particularly useful in nursing education, where the acquisition of accurate theoretical knowledge is essential for safe medication administration and the development of clinical competence.

The study findings revealed an increase in the mean knowledge score from 10.80 (SD = 3.20) in the pre-test to 17.20 (SD = 2.50) in the post-test, with a mean difference of 6.40 ($p = 0.001$). This improvement suggests that the blended flipped learning and teaching strategy was associated with enhanced knowledge regarding the IM injection procedure. Access to digital learning resources before classroom sessions may have enabled students to become familiar with essential procedural concepts, including injection sites, anatomical landmarks, equipment selection, medication safety, infection prevention, and potential complications. The subsequent classroom sessions provided opportunities to clarify misconceptions and reinforce important principles through instructor-guided teaching and interactive discussion.

The improvement in knowledge may also be explained by the active learning opportunities provided through the flipped classroom model. In conventional lecture-based teaching, students may primarily receive information during scheduled classroom hours. In contrast, flipped learning encourages learners to engage with instructional materials before attending class, allowing classroom time to be used for discussion, application, and feedback. Students can revisit videos and presentations to

clarify difficult concepts, while educators can identify knowledge gaps and provide targeted explanations. These features may improve comprehension and retention of information related to procedural nursing skills.

The distribution of knowledge levels further demonstrated improvement following the intervention. The proportion of students classified as having adequate knowledge increased from 13.3% in the pre-test to 66.7% in the post-test. Conversely, the proportion with inadequate knowledge decreased from 40.0% to 5.0%. This shift indicates that more students achieved the predefined adequate knowledge category following the educational programme. Such improvement is relevant because a clear understanding of procedural steps, anatomical considerations, and infection prevention measures provides an important foundation for safe clinical practice. Nevertheless, adequate theoretical knowledge alone does not establish that students can perform an IM injection correctly, and practical competency should be assessed separately through supervised skills demonstrations or an objective structured clinical examination.

The study also examined the association between baseline knowledge levels and selected demographic variables. A statistically significant association was observed between previous exposure to an IM injection demonstration and pre-test knowledge levels ($p = 0.040$). This finding suggests that prior exposure to procedural teaching may be related to students' existing understanding of the procedure. Demonstrations can help learners visualize procedural sequences, recognize relevant anatomical landmarks, and connect theoretical concepts with clinical applications. However, the observed association does not establish that previous exposure caused higher knowledge levels, because other factors, such as academic performance, prior learning opportunities, and individual study habits, may also influence knowledge acquisition.

No statistically significant associations were observed between baseline knowledge levels and age ($p = 0.585$), gender ($p = 0.571$), or year of study ($p = 0.089$). These results indicate that statistically significant differences were not detected for these variables within the study sample. However, the findings should be interpreted cautiously, as the sample size and distribution of participants across categories may affect the ability to identify associations. The absence of statistical significance should not be interpreted as evidence that these variables can never influence learning outcomes.

From a nursing education perspective, the findings support consideration of blended flipped learning as a teaching approach for procedural knowledge development. Nurse educators can provide short instructional videos, digital presentations, structured reading materials, and preparatory questions before classroom sessions. Classroom time can then focus on active discussion, clarification of doubts, case-based questions, and instructor-guided demonstrations. Combining digital resources with face-to-face instruction may also offer students greater flexibility to revisit content and learn at an individual pace. To maximize its usefulness, educators should ensure that learning resources are accurate, accessible, aligned with current clinical guidelines, and appropriate to students' learning needs.

The findings have implications for medication safety and clinical education. Intramuscular injections require appropriate site selection, adherence to medication administration principles, infection prevention, and awareness of potential complications. Inadequate understanding of these elements may increase the risk of procedural errors. Therefore, innovative teaching strategies should be integrated with opportunities for supervised practice, timely feedback, and competency assessment. A comprehensive educational approach that combines theoretical preparation, demonstration, simulation, and supervised clinical experience may better prepare nursing students for safe performance of injection procedures.

Despite the observed improvement, several methodological considerations should be acknowledged. A one-group pre-test and post-test design does not include a control group and cannot fully exclude alternative explanations for the improvement, such as repeated testing, independent study, or exposure to other educational resources. If knowledge was measured immediately after the intervention, the findings may not reflect long-term retention. In addition, knowledge scores cannot be used as a substitute for direct assessment of practical performance. Future studies should consider randomized or controlled designs, larger samples, delayed post-tests, and objective assessments of procedural competency. Further research could also compare blended flipped learning with conventional teaching to determine its relative effectiveness and feasibility in different nursing education settings.

In conclusion, the study findings indicate that the blended flipped learning and teaching strategy was associated with improved knowledge regarding the IM injection procedure among nursing students. The increase in mean knowledge scores and the shift toward adequate knowledge levels highlight the potential value of integrating pre-class digital learning with interactive classroom teaching. Nurse educators may consider this approach as part of a broader teaching strategy that includes demonstration, supervised practice, and formal competency assessment. Further controlled research is needed to establish the comparative effectiveness of this approach and determine whether improvements in knowledge are sustained over time and translated into better practical performance.

Conclusion

The present study concluded that the blended flipped learning and teaching strategy was associated with improved knowledge regarding the intramuscular (IM) injection procedure among nursing students. The mean knowledge score increased from 10.80 in the pre-test to 17.20 in the post-test, demonstrating a statistically significant improvement ($p = 0.001$). The proportion of students with adequate knowledge increased from 13.3% to 66.7% following the educational intervention. A significant association was also identified between previous exposure to IM injection demonstrations and baseline knowledge levels. These findings highlight the potential value of integrating digital learning resources with interactive classroom teaching to strengthen procedural knowledge among nursing students. Nurse educators may consider incorporating blended flipped learning into nursing curricula alongside instructor-guided demonstrations, supervised clinical practice, and objective competency assessments to promote safe medication administration. Further studies

using controlled research designs and longer follow-up periods are recommended to evaluate knowledge retention and practical competency.

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Conflict of Interest

The author declares no conflict of interest related to the research, authorship, or publication of this article.

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