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Original Article

Impact Of Image-Assisted Teaching on The Comprehension and Retention of Anatomical Terminology Among First-Year MBBS Students: A Comparative Interventional Study

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ABSTRACT

Background: Anatomical terminology forms the foundation of medical education; however, first-year MBBS students often face difficulties in understanding and retaining anatomical terms due to their complexity and unfamiliarity. Image-assisted teaching has emerged as a promising educational strategy that may enhance learning through visual reinforcement.

Aim: To evaluate the effectiveness of image-assisted teaching on the comprehension and retention of anatomical terminology among first-year MBBS students.

Materials and Methods: This comparative interventional study was conducted among 180 first-year MBBS students, who were randomly allocated into a control group (n=90) and an experimental group (n=90). The control group received conventional teaching, while the experimental group received image-assisted instruction using labeled anatomical diagrams and illustrations. Baseline knowledge was assessed using a pre-test. Immediate learning outcomes were evaluated through a post-test conducted immediately after the intervention, and long-term retention was assessed using a delayed post-test after four weeks. Student perceptions regarding image-assisted learning were collected using a validated Likert-scale questionnaire. Statistical analysis was performed using Student's t-test, with $p<0.05$ considered significant.

Results: Baseline demographic characteristics and pre-test scores were comparable between the groups ($p>0.05$). Both groups demonstrated significant improvement in post-test scores following instruction ($p<0.001$). However, the experimental group achieved significantly higher immediate post-test scores (16.8±1.9 vs. 13.2±2.3) and greater learning gain (8.2±2.0 vs. 4.8±1.9) compared with the control group ($p<0.001$). Four-week retention scores were also significantly higher among students receiving image-assisted teaching (15.9±2.0 vs. 11.8±2.4; $p<0.001$). More than 95% of students in the experimental group reported that visual aids improved understanding, engagement, and retention of anatomical terminology.

Conclusion: Image-assisted teaching significantly improves both comprehension and long-term retention of anatomical terminology among first-year MBBS students. Incorporating visual learning resources into undergraduate anatomy education may enhance academic performance, knowledge retention, and student engagement.

Keywords*: Anatomy education; Anatomical terminology; Image-assisted teaching; Visual learning; Knowledge retention; Medical education; MBBS students; Multimedia learning.*

INTRODUCTION

Anatomy forms the cornerstone of medical education and provides the essential language through which healthcare professionals communicate structural and clinical information. A sound understanding of anatomical terminology is fundamental for medical students, as these terms constitute the basis for learning anatomy, physiology, pathology, and clinical medicine. However, first-year MBBS students often encounter difficulties in comprehending and retaining anatomical terms due to their complexity, unfamiliarity, and extensive use of Latin and Greek derivations. Such challenges can adversely affect academic performance and long-term retention of anatomical concepts.[1]

Traditional anatomy teaching has largely relied on didactic lectures, textbook reading, and rote memorization of anatomical nomenclature. While these methods remain important, they may not adequately address the diverse learning preferences of contemporary students. Medical education is increasingly shifting toward learner-centered approaches that promote active engagement and meaningful understanding rather than passive memorization.[2]

Visual learning strategies have emerged as effective tools for enhancing comprehension and memory retention in health professions education. According to the Dual Coding Theory proposed by Paivio, information presented simultaneously in verbal and visual formats is processed through separate cognitive channels, resulting in stronger memory encoding and retrieval.[3] Similarly, Mayer's Cognitive Theory of Multimedia Learning suggests that appropriately designed visual materials facilitate deeper understanding by integrating words and images into coherent mental representations[4].

In anatomy education, images such as diagrams, illustrations, labeled figures, and digital visual aids play a crucial role in conveying complex spatial relationships and anatomical structures. Visual representations can simplify abstract concepts, improve learner engagement, and reduce cognitive load. Several studies have demonstrated that image-based and multimedia-assisted teaching methods enhance students' understanding of anatomical concepts and improve knowledge retention compared with conventional teaching approaches[5-7]. Furthermore, the increasing availability of digital educational resources has encouraged the integration of visual learning tools into undergraduate medical curricula worldwide[8].

Despite growing evidence supporting image-assisted learning, limited studies have specifically investigated its impact on the comprehension and retention of anatomical terminology among first-year MBBS students. Understanding anatomical terminology is particularly important during the early stages of medical education because it serves as the foundation for subsequent learning and clinical communication. Evaluating innovative teaching strategies that facilitate the acquisition of anatomical vocabulary may therefore contribute to improved educational outcomes.

The present study was designed to assess the effectiveness of image-assisted teaching in enhancing the comprehension and retention of anatomical terminology among first-year MBBS students. By comparing image-assisted instruction with conventional teaching methods, this study aims to determine whether the incorporation of visual aids can significantly improve students' understanding and long-term recall of anatomical terms.

MATERIALS AND METHODS

Study Design and Setting: This comparative interventional study was conducted in the Department of Anatomy in a tertiary care centre, India, after obtaining approval from the Institutional Ethics Committee. The study was carried out among first-year MBBS students during the academic session 2025–2026 to evaluate the effectiveness of image-assisted teaching on the comprehension and retention of anatomical terminology.

Study Participants

A total of 180 first-year MBBS students who provided informed consent and fulfilled the eligibility criteria were enrolled in the study.

Inclusion Criteria

- First-year MBBS students willing to participate in the study.
- Students with ≥75% attendance in anatomy theory and practical classes.

Exclusion Criteria

- Students with <75% attendance in anatomy theory or practical sessions.
- Students who were absent during any of the assessment sessions.

After enrollment, participants were randomly allocated into two equal groups:

Control Group (n = 90): Students received conventional teaching consisting of a structured lecture explaining the meanings, definitions, and usage of selected anatomical terms through verbal and textual instruction.

Experimental Group (n = 90): Students received image-assisted teaching on the same anatomical terminology. The instructional session incorporated PowerPoint-based visual aids, including labeled anatomical images, diagrams, and illustrations that were directly linked to the etymological meanings and anatomical relevance of the terms.
Both groups were taught by the same faculty member using identical learning objectives and duration of instruction to minimize instructor-related bias**.**

Assessment of Learning Outcomes
Pre-test Assessment: Before the intervention, all participants completed a standardized pre-test consisting of multiple-choice and short-answer questions related to selected anatomical terminology. The pre-test was used to assess baseline knowledge and ensure comparability between the groups.

Immediate Post-test Assessment: Immediately after completion of the teaching session, students undertook post-test comprising questions similar in difficulty and content to the pre-test. The difference between pre-test and post-test scores was used to evaluate immediate comprehension and learning gain.

Retention Assessment: To assess long-term retention, a delayed post-test was administered four weeks after the intervention. The retention test evaluated the ability of students to recall and correctly interpret the anatomical terms learned during the teaching sessions.

Student Feedback: Following completion of the retention assessment, students in the experimental group completed a pre-validated feedback questionnaire. Responses were recorded using a five-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree." The questionnaire evaluated students' perceptions regarding understanding, memorization, engagement, usefulness of visual aids, and overall satisfaction with image-assisted learning.

Outcome Measures
Primary Outcome
- Difference in mean post-test scores between the control and experimental groups.

Secondary Outcomes
- Difference in retention test scores between the groups.
- Change in scores from pre-test to post-test.
- Student perception and satisfaction regarding image-assisted teaching.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 26.0. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Within-group comparisons of pre-test and post-test scores were performed using paired Student's t-test. Between-group comparisons were analyzed using independent Student's t-test. Feedback responses were summarized descriptively. A p-value <0.05 was considered statistically significant**.**

RESULTS
Among 180 first-year MBBS students, baseline characteristics and pre-test scores were comparable between groups ($p>0.05$). Both groups showed significant improvement in immediate post-test scores following instruction ($p<0.001$). However, students receiving image-assisted teaching demonstrated significantly higher post-test scores (16.8±1.9 vs 13.2±2.3) and greater learning gain (8.2±2.0 vs 4.8±1.9) than those receiving conventional teaching ($p<0.001$). Four-week retention scores were also significantly higher in the experimental group (15.9±2.0) compared with the control group (11.8±2.4), indicating superior long-term retention of anatomical terminology. Student feedback revealed overwhelmingly positive perceptions toward image-assisted learning, with more than 95% of participants agreeing that visual aids improved understanding, engagement, and retention of anatomical terminology.

Table 1: Baseline Characteristics of Study Participants

Variable	Control Group (n=90)	Experimental Group (n=90)	p-value
Age (years), Mean ± SD	18.7 ± 0.8	18.8 ± 0.7	0.42
Male, n (%)	49 (54.4)	51 (56.7)	0.76
Female, n (%)	41 (45.6)	39 (43.3)	0.76
Pre-test Score (out of 20), Mean ± SD	8.4 ± 2.1	8.6 ± 2.0	0.53

Table 2: Comparison of Pre-test and Immediate Post-test Scores within Groups

Group	Pre-test Score	Immediate Post-test Score	Mean Difference	p-value

Control (n=90)	8.4 ± 2.1	13.2 ± 2.3	4.8 ± 1.9	<0.001
Experimental (n=90)	8.6 ± 2.0	16.8 ± 1.9	8.2 ± 2.0	<0.001

Table 3: Comparison of Learning Gain between Groups

Parameter	Control Group	Experimental Group	p-value
Learning Gain Score	4.8 ± 1.9	8.2 ± 2.0	<0.001

Table 4: Comparison of Retention Scores after Four Weeks

Group	Retention Score (out of 20)	p-value
Control (n=90)	11.8 ± 2.4	<0.001
Experimental (n=90)	15.9 ± 2.0	

Table 5: Retention Rate

Group	Post-test Score	Retention Score	Retention Rate (%)
Control	13.2 ± 2.3	11.8 ± 2.4	89.4
Experimental	16.8 ± 1.9	15.9 ± 2.0	94.6

Table 6: Student Feedback Regarding Image-Assisted Teaching (n=90)

Statement	Strongly Agree N (%)	Agree N (%)	Neutral N (%)	Disagree N (%)	Strongly Disagree N (%)
Images improved understanding	58 (64.4)	28 (31.1)	4 (4.5)	0	0
Images improved retention	55 (61.1)	31 (34.4)	4 (4.5)	0	0
Learning became more interesting	62 (68.9)	24 (26.7)	4 (4.4)	0	0
Visual aids reduced difficulty	57 (63.3)	29 (32.2)	4 (4.5)	0	0
Recommend for future teaching	65 (72.2)	22 (24.4)	3 (3.4)	0	0

DISCUSSION

At baseline, both groups were comparable with respect to age, gender distribution, and pre-test scores, indicating homogeneity between groups and minimizing the likelihood of selection bias. Following the intervention, significant improvements were observed within both groups; however, the experimental group achieved significantly higher immediate post-test scores and learning gain scores than the control group. These findings suggest that the integration of visual aids enhances the understanding of anatomical terminology beyond that achieved through traditional text-based instruction alone.

The superior performance of the image-assisted group may be explained by Paivio's Dual Coding Theory[3], which proposes that information presented through both verbal and visual channels is encoded more effectively in memory, leading to improved retrieval and understanding. Similarly, Mayer's Cognitive Theory[4] of Multimedia Learning emphasizes that meaningful learning occurs when learners integrate words and images into coherent mental representations. The present findings support these theoretical frameworks and indicate that visual representations facilitate deeper cognitive processing of anatomical concepts.

A particularly important finding of this study was the significantly higher retention score observed in the image-assisted group four weeks after instruction. While some decline from immediate post-test performance was expected, students exposed to visual learning aids retained a larger proportion of acquired knowledge than those taught conventionally. The retention rate of 94.6% in the experimental group compared with 89.4% in the control group suggests that image-assisted learning promotes more durable memory formation. Similar observations have been reported in anatomy education studies, where diagrams, illustrations, and multimedia resources improved long-term recall and conceptual understanding of complex anatomical structures[9, 10].

Student perception data further reinforced the effectiveness of image-assisted teaching. More than 95% of participants agreed that visual aids improved understanding, enhanced retention, reduced learning difficulty, and made learning more engaging. The highest level of agreement was observed for recommending image-assisted learning in future teaching sessions. These findings indicate high learner acceptance and suggest that visual teaching strategies not only improve academic performance but also increase student motivation and engagement[11, 12].

The findings are consistent with previous studies reporting the educational benefits of visual and multimedia-assisted learning in anatomy and other health science disciplines. Advances in educational technology have enabled greater incorporation of images, animations, and digital resources into medical curricula, and the present study provides further evidence supporting their pedagogical value in foundational medical education[13-15].

Despite its strengths, the study has certain limitations. It was conducted at a single institution and evaluated retention over a relatively short follow-up period of four weeks. Additionally, only selected anatomical terms were assessed, which may limit generalizability to the entire anatomy curriculum. Future multicentric studies with longer follow-up periods and integration of advanced digital visualization tools may provide further insights into the long-term educational impact of image-assisted learning.

CONCLUSION

Image-assisted teaching significantly enhanced both the comprehension and retention of anatomical terminology among first-year MBBS students compared with conventional teaching methods. Students exposed to visual aids demonstrated greater immediate learning gains, superior long-term retention, and highly positive perceptions regarding the learning experience. The findings suggest that incorporating image-based instructional strategies into undergraduate anatomy education can improve understanding, facilitate memory retention, and promote student engagement, making it a valuable adjunct to traditional teaching approaches.

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