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Effectiveness of Small Group Interactive Teaching in Physiology for Enhancing Clinical Application among Medical Students

Running Title: **Small Group Interactive Teaching in Physiology**

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KEYWORDS

Small Group Interactive Sessions (SGIS), Physiology Education, Clinical Application, Knowledge Retention, Undergraduate Medical Education

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Abstract

Background: A gap often exists between the learning of Physiology and its application in clinical practice among undergraduate medical students. Small Group Interactive Sessions (SGIS) have been proposed as an active learning strategy to enhance understanding, clinical reasoning, and application of physiological concepts. This study evaluated the effectiveness of SGIS in improving clinical application skills among final MBBS students.

Materials and Methods: A quasi-experimental study was conducted among 60 final MBBS students posted in the Department of General Medicine at SVMCH&RC. Participants underwent faculty-facilitated SGIS focusing on clinically relevant Physiology topics through case-based discussions, clinical scenario-based questions, peer interaction, and feedback. A 40-item MCQ-based pre-test and post-test were administered to assess knowledge and clinical application. Student perceptions were collected using a validated 5-point Likert scale questionnaire, and qualitative feedback was analyzed using thematic analysis. Quantitative data were analyzed using the Wilcoxon Signed-Rank Test.

Results: The mean pre-test score was 23.01 ± 2.38, which increased significantly to 33.76 ± 2.28 following the intervention, with a mean improvement of 10.75 points. Wilcoxon Signed-Rank Test demonstrated a highly significant difference between pre-test and post-test scores ($Z = +6.785$, $p < 0.001$). Qualitative analysis revealed five major themes: reinforcement of foundational concepts, improved clinical correlation, active engagement, enhanced confidence and preparedness for clinical postings, and strong student support for continuation of SGIS. Students perceived SGIS as interactive, effective, and beneficial for applying physiological concepts to clinical scenarios.

Conclusion: SGIS is an effective educational strategy for enhancing clinical application of Physiology among final MBBS students. It improves knowledge, engagement, confidence, and preparedness for clinical practice while bridging the gap between basic science learning and clinical application.

INTRODUCTION:

In undergraduate medical education, there is often a noticeable gap between pre-clinical learning of Physiology and its application during clinical postings. Final MBBS students frequently experience difficulty in correlating physiological concepts with real patient scenarios, which may affect their clinical reasoning, confidence, and overall preparedness of ward responsibilities. Research consistently shows that small group interaction promotes active learning, critical thinking, communication, teamwork, and retention of medical knowledge compared to passive lecture-based

approaches. For instance, interactive small group discussions in physiology significantly improved student performance and engagement, helping learners analyze, synthesize, and integrate knowledge with confidence (1).

A study by Shankar *et al.* found that small group processes created a supportive learning environment and helped students apply physiological principles to clinical scenarios more effectively than didactic lectures alone (2). Students generally view small group discussions as interactive, friendly, and effective for building communication skills and promoting deeper understanding. According to Annamalai *et al.*, the majority of students perceived small group discussion as enhancing interaction, thought process, and teacher-student rapport (3).

Similarly, research indicates that case-based small group discussions correlate positively with overall academic performance in physiology, supporting their value in foundational biomedical education (4). Although much of the literature focuses on small group teaching during pre-clinical phases, the underlying outcomes are relevant to preparing students for clinical application. Small group and team-based learning methods enhance engagement, accountability, and deep learning, which are essential for later clinical reasoning and patient care (5).

Furthermore, even when implemented within pre-clinical physiology courses, interventions involving structured discussion, case-based formats, and simulation have demonstrated enhanced conceptual understanding and confidence—essential components of clinical preparedness (6). Research conducted in clinical clerkship settings demonstrates that, in comparison to traditional forms, interactive, small-group courses with systematic feedback can greatly enhance clinical skills, interpersonal abilities, and long-term performance (7). This lends credence to the idea that, when used prior to clinical posting, interactive instructional modules like SGIS could have a favorable impact on both knowledge and real-world clinical application.

Small Group Interactive Sessions (SGIS) have been shown to promote active learning, improve conceptual clarity, and enhance clinical correlation skills. However, limited evidence exists within our institution regarding the effectiveness of SGIS using a structured Physiology instructional module prior to clinical posting among final MBBS

students. Therefore, there is a need to systematically evaluate whether implementing SGIS before clinical postings improves knowledge retention, clinical application, and student confidence, thereby enhancing overall clinical preparedness.

AIM:

To assess the effectiveness of small group interactive teaching in Physiology in enhancing clinical application skills among medical students.

OBJECTIVES:

1. To evaluate the improvement in students' ability to apply physiological concepts to clinical scenarios after small group interactive sessions.
2. To compare the pre- and post-intervention performance of students in clinical problem-solving related to Physiology.

MATERIALS AND METHODS:

Type of study	: Quasi-Experimental Study
Study population	: Final MBBS students posted in the General Medicine department
Study area	: Department of General Medicine at SVMCH&RC
Study period	: 1 month
Sampling technique	: Convenient sampling
Sample size	: 60 final MBBS students

Sample Size Calculation:

The sample size was determined based on a similar quasi-experimental study by Vasudevan et al. (2024), which evaluated the effectiveness of small group teaching among undergraduate medical students. The study reported a significant improvement in mean post-test scores compared to pre-test scores, with a moderate effect size (8).Considering a 10–20% non-response/attrition rate, the sample size was increased to 60 students. Thus, a total of 60 final MBBS students were included in the study.

ELIGIBILITY CRITERIA:

Inclusion criteria:

1. Final MBBS students posted in General Medicine
2. Students who provide informed written consent

Exclusion criteria:

1. Students who are absent during intervention sessions
2. Students who do not complete both pre-test and post-test

Data collection and analysis plan: The approval of the Scientific Research and Ethics committees were obtained and the informed written consent was taken from all the students prior to the study. Structured Physiology instructional sessions on clinically relevant topics including cardiovascular, respiratory, and acid–base balance physiology was developed after discussion with the Head of the Department of Medicine, incorporating commonly encountered clinical case scenarios to enhance clinical application of physiological concepts. The Students were divided into two batches (A & B) of 30 each:

Each of these batches was divided into two subgroups of 15 each. The small group interactive session was conducted separately with identical content and facilitator. Each session lasted 15–20 minutes and were conducted before clinical posting. The teaching methods included Case-based discussions, Clinical scenario-based questions, Interactive questioning and peer discussion & Faculty facilitation and feedback.

Study Procedure: The study was conducted in five phases: preparation, pre-test, intervention, post-test, and feedback assessment. During the preparation phase, instructional sessions and study instruments were developed and validated. Participants first completed a 40-item MCQ-based pre-test assessing applied Physiology knowledge. This was followed by faculty-facilitated Small Group Interactive Sessions (SGIS) focusing on clinically relevant physiological concepts. Immediately after the intervention, students completed an equivalent MCQ-based post-test to assess learning outcomes while minimizing recall bias.

Finally, participants completed a pre-validated 5-point Likert scale questionnaire evaluating conceptual understanding, clinical application, engagement, communication skills, self-directed learning, and confidence and preparedness, along with open-ended feedback questions. Both quantitative and qualitative aspects were

analysed by pre-intervention and post-intervention test scores and structured Likert-scale questionnaire respectively and the data were analysed using SPSS version 23.0. Thematic analysis was used for Qualitative analysis.

STATISTICAL ANALYSIS:

Data were entered and analyzed using SPSS version 23.0. Quantitative data were analyzed using descriptive statistics such as mean, standard deviation, and percentages. Inferential statistics, including the paired t-test, were used to compare pre-test and post-test scores, with statistical significance set at $p < 0.05$. Qualitative data obtained from open-ended responses were analyzed through thematic analysis, where codes and themes were manually identified and interpreted.

RESULTS:

The Wilcoxon Signed-Rank Test was performed to assess the effectiveness of the educational intervention among 60 participants. The mean pre-test score was 23.01 ± 2.38, which increased to 33.76 ± 2.28 in the post-test assessment (Table 1). The mean improvement was 10.75 points**.** The analysis demonstrated a statistically significant difference between pre-test and post-test scores **(**$Z = +6.785$, $p < 0.001$**)**, indicating that the intervention resulted in a significant enhancement of participants' knowledge. Therefore, the educational intervention was found to be highly effective.

Table 1. Comparison of Pre-test and Post-test Scores Using the Wilcoxon Signed-Rank Test (N = 60)

Variable	Pre-test Mean ± SD	Post-test Mean ± SD	Mean Difference	Z Value	p Value	Significance
Knowledge Score	23.01 ± 2.38	33.76 ± 2.28	10.75	+6.785	< 0.001	Highly Significant*

Wilcoxon Signed-Rank Test: T = 0.00; Z = +6.785; N = 60

*Significant at $p < 0.05$

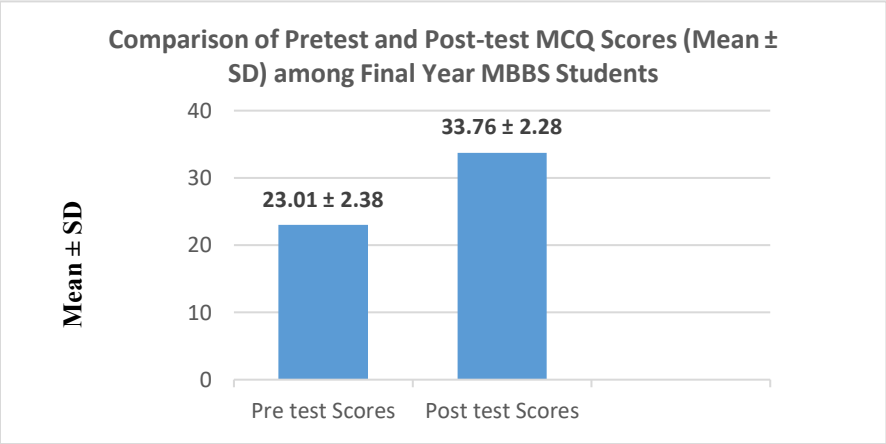
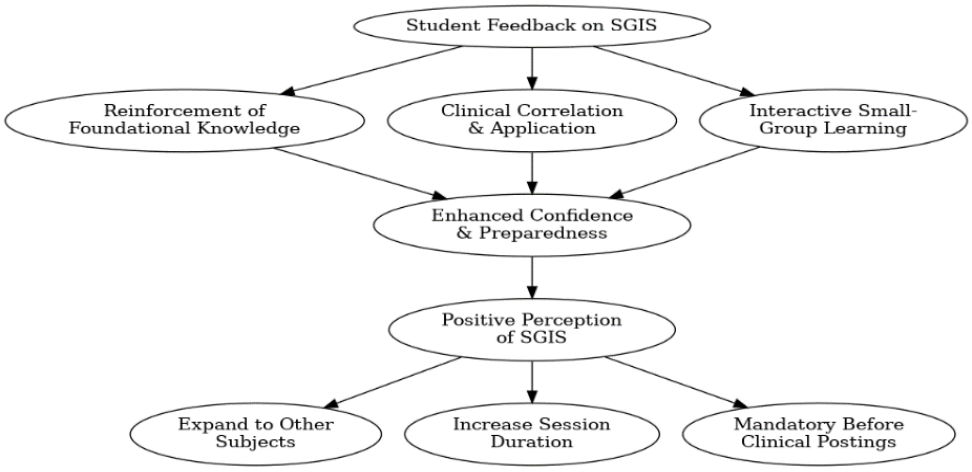


Fig 1: Wilcoxon signed-rank test revealed a significant increase in post-test scores (M = 33.76, SD = 2.28) compared with pre-test scores (M = 23.01, SD = 2.38), Z = +6.785, p < .001, indicating the effectiveness of the intervention.

Thematic Map:



Thematic analysis of the open-ended feedback revealed five major themes. Students perceived the Small Group Interactive Sessions (SGIS) as an effective strategy for reinforcing foundational Physiology concepts and facilitating their application to clinical practice. The small-group format promoted active engagement, enhanced understanding of difficult concepts, and provided opportunities for

revision of previously learned material. Participants also reported increased confidence and preparedness for clinical postings. Furthermore, students expressed strong support for the continuation and expansion of SGIS, recommending its implementation in other disciplines and before clinical postings. Overall, the findings suggest that SGIS is a well-accepted educational intervention that effectively bridges basic science learning with clinical application.

DISCUSSION:

The present study evaluated the effectiveness of Small Group Interactive Sessions (SGIS) in Physiology for enhancing clinical application skills among final MBBS students. The findings demonstrated a statistically significant improvement in post-test scores compared with pre-test scores, indicating that SGIS effectively enhanced students' understanding and application of physiological concepts in clinical contexts. In addition, students reported highly positive perceptions regarding conceptual understanding, clinical application, engagement, communication skills, self-directed learning, and confidence in clinical postings.

Compared to traditional lecture-based techniques, small-group learning encourages active engagement and cooperative problem-solving, which helps students construct knowledge more successfully. The results of Walton & Oswald, who found that small-group learning improves student engagement and critical thinking—two skills necessary for applying physiological knowledge in clinical settings—are in line with the notable improvement in knowledge scores seen in this study (9).

Recent trends in physiology education further emphasize the importance of active learning approaches. He et al. reported a growing emphasis on active learning strategies because of their positive impact on conceptual understanding, retention, and long-term application of knowledge (10). The findings of the present study add to this growing body of evidence and support the incorporation of structured SGIS into undergraduate medical curricula.

The present findings also support the work of Asem and Rajwa, who reported that combining lectures with small-group discussions significantly improved students' performance in Physiology compared with lectures alone (11). Interactive discussion allows students to clarify misconceptions,

actively process information, and integrate theoretical concepts with practical applications. This may explain the substantial improvement observed in post-intervention scores in the current study.

The intervention's primary goal was to close the knowledge gap between clinical practice and basic science education. Students stated that SGIS enhanced their clinical reasoning abilities and assisted them in connecting physiological ideas with patient care. These results are consistent with those of Slater et al., who highlighted that incorporating physiology into clinical instruction improves learning outcomes and increases the perceived relevance of basic sciences (12). This integration was probably made easier and meaningful learning was encouraged by the current study's use of clinically focused case scenarios.

The positive student perceptions observed across all domains further support the educational value of SGIS. Most participants agreed that the sessions were interactive, engaging, and beneficial for understanding difficult concepts. Similar findings were reported by Asem, who found that students perceived small-group discussions as an effective teaching-learning strategy that improved engagement, understanding, and overall satisfaction (13). The small-group environment encourages participation, peer interaction, and open discussion, creating a supportive learning atmosphere.

Thematic analysis of the qualitative feedback revealed that students valued the opportunity to revise foundational concepts, strengthen clinical correlations, and improve confidence before clinical postings. These findings align with the review by Burgess et al., who concluded that small-group teaching enhances cognitive, emotional, and behavioral engagement while supporting competency development in medical education (14). The authors highlighted that active participation and feedback are key factors contributing to improved learning outcomes.

The active learning strategy used during SGIS may also be responsible for the students' reported increases in confidence and readiness in this study. Annamalai et al. found that active teaching tactics significantly enhanced post-test performance and learner confidence (15). Students' nervousness may have decreased and their preparedness for patient-based conversations and clinical duties may have improved after being exposed to clinical scenarios in a supportive learning environment.

Overall, the study demonstrates that SGIS is an effective educational strategy for enhancing knowledge acquisition, clinical application, engagement, and confidence among final MBBS students. By facilitating active learning and promoting integration of basic science with clinical practice, SGIS can serve as a valuable component of competency-based medical education and contribute to improved clinical preparedness among future physicians.

CONCLUSION:

The present study demonstrated that Small Group Interactive Sessions (SGIS) in Physiology significantly enhanced the ability of final MBBS students to apply physiological concepts to clinical scenarios. The intervention resulted in a significant improvement in post-test scores and was positively perceived by students across multiple domains, including conceptual understanding, clinical application, engagement, communication skills, self-directed learning, and confidence in clinical postings. Qualitative feedback further indicated that SGIS facilitated revision of foundational concepts, strengthened clinical correlation, and improved preparedness for patient-based discussions. These findings suggest that SGIS is an effective educational strategy for bridging the gap between basic science learning and clinical practice and aligns well with the principles of Competency-Based Medical Education.

Future research should include multicenter studies involving larger and more diverse student populations to enhance the generalizability of findings. Longitudinal studies are needed to evaluate the long-term retention of knowledge and the sustained impact of SGIS on clinical performance. Comparative studies examining SGIS alongside other active learning approaches, such as team-based learning, problem-based learning, and simulation-based teaching, would help identify the most effective instructional strategies. Further research may also explore the influence of SGIS on objective clinical outcomes, including workplace-based assessments, OSCE performance, and patient-care competencies. Additionally, investigating faculty perceptions, implementation challenges, and the integration of digital technologies within SGIS may provide valuable insights for optimizing its effectiveness in undergraduate medical education. This approach also ensures stronger alignment with Competency-Based Medical Education principles, supports the growth of medical education research and scholarly

publications, and contributes to the overall improvement in institutional academic quality along with better compliance with NMC and NAAC benchmarks.

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