

Effectiveness of Self-Directed Learning through Nesting by Near - Peer Teaching for Phase I MBBS Students: An Interventional Study

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ABSTRACT:

Background: Self-directed learning (SDL) is a learner-centered educational strategy that promotes autonomy, critical thinking, and lifelong learning. Near-peer teaching, in which senior students facilitate learning for junior students, has emerged as an effective approach to enhance engagement and understanding. Integrating near-peer teaching with a nesting approach that introduces higher-phase concepts into Phase I teaching may further strengthen SDL.

Objective: To evaluate the effectiveness and acceptability of near-peer-assisted SDL through nesting among Phase I MBBS students and compare learning outcomes with conventional SDL.

Methods: This interventional educational study was conducted in the Department of Biochemistry at Netaji Subhash Chandra Bose Medical College, Jabalpur, MP, India, from March to October 2025. A total of 250 Phase I MBBS students were enrolled. Ten Phase III MBBS students served as near-peer tutors. Students were divided into conventional SDL and near-peer-assisted SDL groups. The intervention incorporated nesting by integrating simplified higher-phase concepts into SDL sessions. Learning outcomes were assessed using pre- and post-tests, while student and tutor perceptions were evaluated using validated structured feedback questionnaires. Comparative analysis of post-test scores was performed using paired t-tests, with $p < 0.05$ considered statistically significant.

Results: Students exposed to near-peer-assisted SDL through nesting achieved significantly higher post-test scores than those undergoing conventional SDL across all batches (Batch A: 25.23

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± 1.12 vs. 15.96 ± 2.49 ; Batch B: 25.42 ± 1.70 vs. 14.28 ± 3.10 ; Batch C: 25.91 ± 2.70 vs. 14.18 ± 1.41 ; $p < 0.0001$ for all comparisons). Most students reported improved conceptual understanding, motivation, critical thinking, retention, and engagement. Open-ended feedback highlighted interactive discussions, effective doubt resolution, and clinical integration as key strengths. Near-peer tutors also reported enhanced communication skills and reinforcement of their own knowledge.

Conclusion: Near-peer-assisted SDL through nesting significantly improved learning outcomes and was highly acceptable to both learners and tutors. Integrating near-peer teaching with nesting represents an effective educational strategy for enhancing self-directed learning and promoting vertical integration within the Competency-Based Medical Education curriculum.

Keywords: Self-directed learning; Near-peer teaching; Nesting; Competency-Based Medical Education.

INTRODUCTION

Self-directed learning (SDL) is an educational approach that promotes active participation, self-motivation, and learner autonomy. Julian Sefton-Green and Maurice Gibbons describe SDL as a process existing to varying degrees in every individual, wherein learners assume responsibility for regulating their cognition, behavior, and acquisition of knowledge. SDL may occur independently or through collaborative peer interactions.¹

Near-peer teaching is an educational strategy in which senior students teach junior students within the same discipline. The concept was introduced by medical educationalist Neil Whitman in the 1980s. The term “near-peer” reflects proximity, though not equivalence, in the level of training between learner and tutor, distinguishing it from same-level peer-assisted learning.² Near-peer teaching has gained importance in medical education because of its ability to improve learner engagement, communication, cognitive congruence, and academic interaction. Medical institutions are currently challenged by increasing student intake, expanding curricular demands, and limited faculty availability. These challenges necessitate innovative and sustainable teaching–

learning methods that encourage active learning and academic engagement. SDL facilitated through near-peer teaching may therefore serve as an effective educational strategy in undergraduate medical education.³

Successful implementation of SDL requires intrinsic motivation, self-regulation, and adequate academic guidance. Although some students adapt effectively to SDL, others may face difficulties due to lack of structure, limited guidance, or unfamiliarity with independent learning strategies. In this context, near-peer-assisted SDL may provide a supportive learning environment by combining learner autonomy with guidance from relatively senior peers

The concept of “nesting” further enhances this approach by integrating relevant higher-phase learning objectives into Phase I teaching sessions in a simplified and clinically oriented manner. Such vertical integration may improve contextual understanding, learner interest, and long-term retention among MBBS students. Based on these considerations objectives of our study were to conduct self-directed learning sessions in Biochemistry through nesting by near-peer interactive teaching among Phase I MBBS students. And compare the learning gains achieved through near-peer assisted SDL by

nesting with conventional SDL and evaluate the effectiveness and acceptability of near-peer assisted SDL by nesting as a strategy for enhancing self-directed learning among Phase I MBBS students.

MATERIALS AND METHODS

Study Design and Setting

This interventional educational study was conducted in the Department of Biochemistry, Netaji Subhash Chandra Bose Medical College, Jabalpur, Madhya Pradesh, India, from March 2025 to October 2025.

Study Participants

The study included Phase I MBBS students of Batch 2024 who attended the SDL sessions and provided informed consent for participation. Students absent on the day of intervention or assessment were excluded from the study. Participants were selected using convenience sampling, and a total of 250 students were enrolled. Additionally, 10 Phase III MBBS students were recruited as near-peer tutors based on academic performance, communication skills, and willingness to participate. Written informed consent was obtained from all near-peer tutors.

Intervention

Students within each practical batch were divided into two groups:

1. Conventional SDL group
2. Near peer assisted SDL group with intervention (near-peer teaching by nesting)

The intervention group underwent self-directed learning facilitated by Phase III MBBS near-peer students. The sessions incorporated a nesting approach, wherein relevant higher-phase concepts and learning objectives were discussed in an integrated and simplified manner. Both groups were provided with identical learning topics, learning resources, session duration, seminar presentation opportunities, and tutor/faculty supervision to maintain comparability. The study intervention included pretest assessment, SDL sessions, seminar

presentations, post-test assessment, and feedback collection. The intervention was conducted across three sessions. Subsequently, a crossover approach was implemented to ensure exposure of all practical batches to near-peer assisted SDL. The primary outcome variable was learning gain, assessed using post-test scores following the SDL sessions. Secondary outcome variables included student perception, learner engagement, motivation, and perceived effectiveness of near-peer teaching by nesting. These variables were assessed using validated structured feedback questionnaires consisting of Likert-scale and open-ended questions. The primary exposure variable was SDL facilitated through near-peer interactive teaching by nesting. Potential confounding factors included prior academic performance, student motivation, attendance, learning preferences, and variability in participation. Interaction with near-peer tutors and exposure to integrated higher-phase objectives were considered potential effect modifiers.

DATA COLLECTION AND MEASUREMENT

Data collection was initiated after informed consent from all participants. Pretest and post-test questionnaires administered before and after the SDL sessions. The same assessment tools, scoring system, and evaluation criteria were used for both study groups. Students' perceptions regarding the effectiveness of near-peer assisted SDL through nesting were assessed using pre-validated feedback questionnaires comprising closed-ended Likert-scale items and open-ended questions. Feedback from near-peer tutors was also collected to evaluate their teaching experience, communication skills, and perceived academic benefit.

Several measures were undertaken to minimize potential sources of bias. Both study groups received identical topics, learning resources, session duration, seminar exposure, and faculty supervision to maintain uniformity in the learning environment. Students were randomly divided into groups during intervention sessions to reduce selection bias. Uniform assessment

methods and scoring criteria were used for all participants to minimize measurement bias. Validated feedback questionnaires were used to improve consistency and reliability of data collection.

STATISTICAL ANALYSIS

Quantitative data obtained from pretest and post-test assessments were expressed as mean $\pm$ standard deviation (SD). Comparative analysis of post-test scores between the conventional SDL group and the near-peer assisted SDL group was performed batch-wise using 'paired t test'. Feedback obtained through Likert-scale questionnaires was analyzed using frequency and percentage distribution. Subgroup analysis was conducted according to practical batch distribution (Batch A, Batch B, and Batch C). Student and near-peer tutor feedback were analyzed separately to evaluate participant interaction and perception regarding the intervention. Students absent during intervention or assessment sessions were

excluded from the final analysis. Statistical significance was considered at a p-value of <0.05 .

ETHICAL CONSIDERATIONS

Institutional Ethics Committee approval was obtained for the study (Approval Letter no. IEC/2025/8948). Written informed consent was obtained from all participating students and near-peer tutors, and confidentiality of collected data was maintained throughout the study.

RESULTS

A total of 250 Phase I MBBS students were enrolled in the study. Students absent during intervention or assessment sessions were excluded from the final analysis. A total of 240 students completed the study and were included in the analysis. Among them, 147 (61.25%) were male students and 93 (38.75%) were female students. Additionally, 10 Phase III MBBS students participated as near-peer tutors during the intervention sessions.

Batch A post-test score (out of 30 marks) (mean $\pm$ SD)	Batch A 1 (SDL by conventional method)	Batch A 2 (exposed to SDL through near peer teaching by nesting)	P – value
	15.96(2.49)	25.23(1.12)	<0.0001
Batch B post-test score (out of 30 marks) (mean $\pm$ SD)	Batch B 1 (SDL by conventional method)	Batch B 2 (exposed to SDL through near peer teaching by nesting)	
	14.28(3.1)	25.42(1.7)	<0.0001
Batch C post-test score (out of 30 marks) (mean $\pm$ SD)	Batch C 1 (SDL by conventional method)	Batch C 2 (exposed to SDL through near peer teaching by nesting)	
	14.18 (1.41)	25.91 (2.70)	<0.0001

(P-value <0.05 considered to be significant)

Table 1: Comparison of results of post-test for batch A,B,C between the two groups in each batch

The improvement in post-test scores among students exposed to SDL through near-peer teaching by nesting was found to be statistically significant ($p < 0.05$), indicating better learning gain following the intervention.

Student Perception Regarding SDL Through Near-Peer Teaching by Nesting

Most students showed a positive perception toward the intervention. The majority of participants selected either "Strongly Agree" or "Agree" for almost all Likert-scale questions.

Students reported that SDL through near-peer teaching by nesting: improved understanding of the topic, enhanced critical thinking, increased motivation for self-learning, improved retention of concepts, made learning Biochemistry more

interesting, and enhanced performance in assessments. A large proportion of students also expressed willingness to participate in more such sessions in the future.

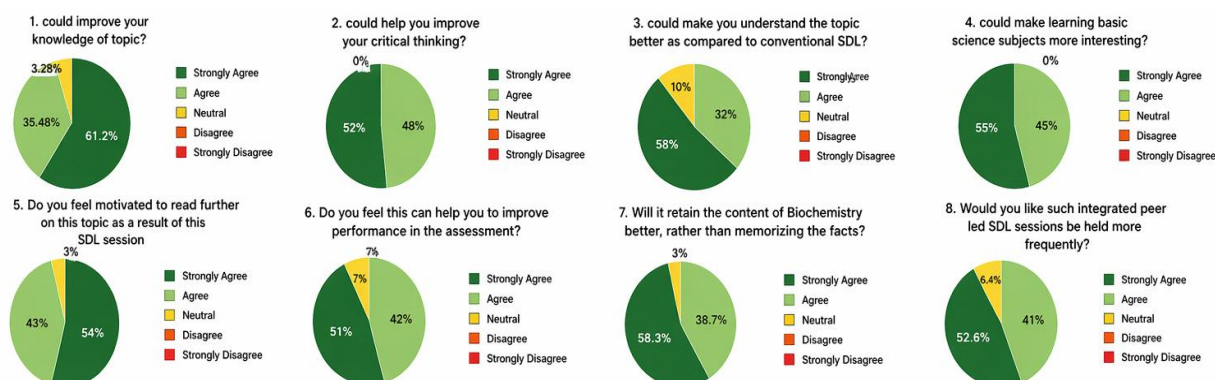


Figure 1. Perception of students of phase 1 MBBS for SDL session by near-peers through nesting (closed ended questions)

Open-Ended Feedback Analysis was done by thematic analysis of open-ended responses revealed that the most appreciated aspects of the sessions were: Interaction with near-peer tutors, doubt-solving approach, better engagement during discussions, sharing of study resources, and integration of clinically relevant higher-phase concepts. Students described the sessions as enjoyable, interactive, motivating, and effective for conceptual understanding.

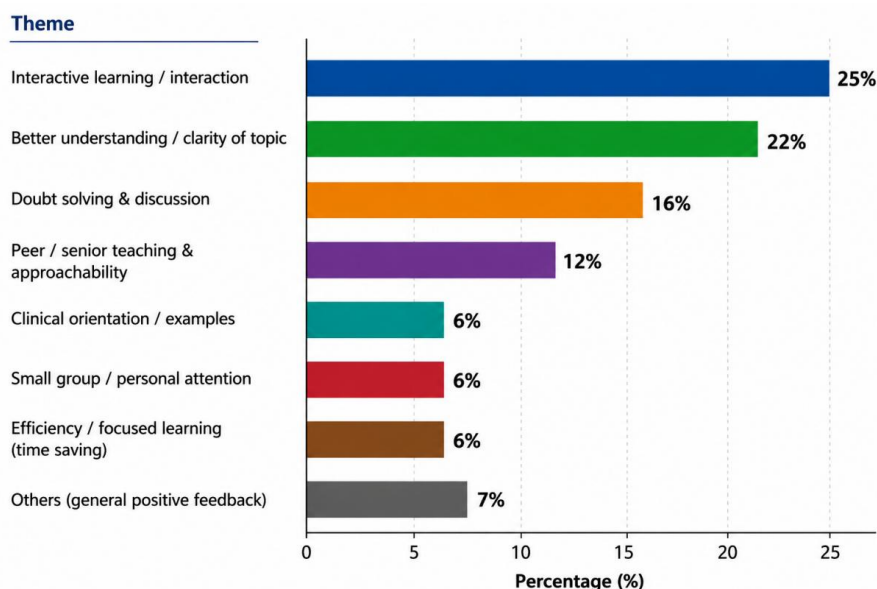


Figure 2. Perception of students of phase 1 MBBS for SDL session by near-peers through nesting (open ended questions: What did you Like the most about this session?)

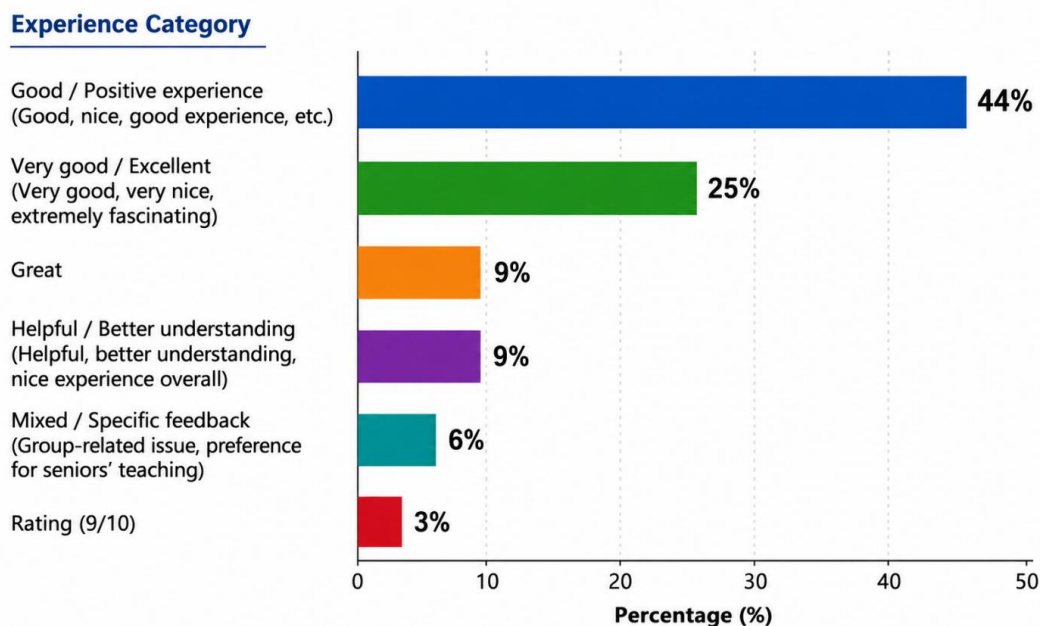


Figure 3. Perception of students of phase 1 MBBS for SDL session by near-peers through nesting (open ended questions: overall experience of the session)

Near-peer students of MBBS phase III reported positive perception regarding the teaching sessions. Most students felt that participation in SDL sessions improved their own conceptual understanding and communication skills. They also appreciated the opportunity to revise and reinforce previously learned concepts and expressed willingness to participate in future sessions.

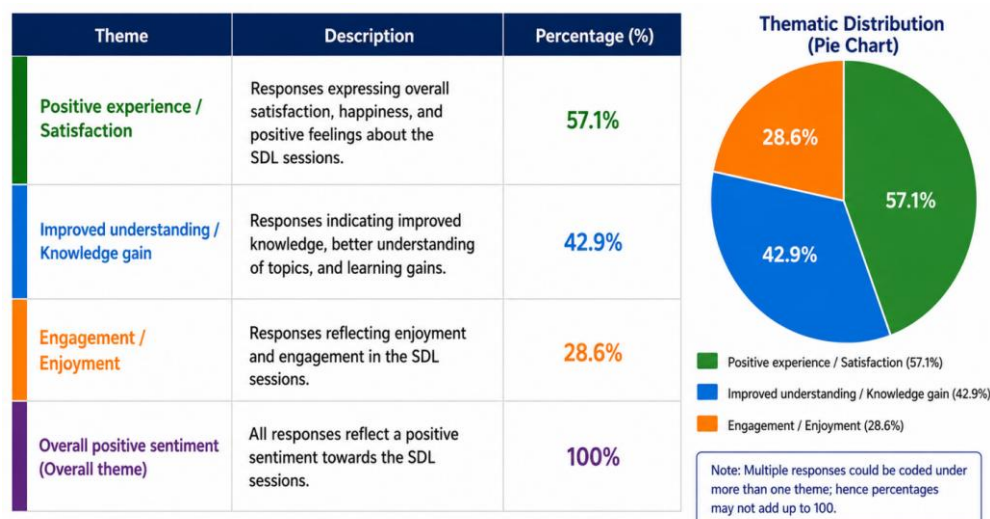


Figure 4. Average feedback scores for the SDL session by near peer students of MBBS phase III

DISCUSSION

The present study evaluated the effectiveness of self-directed learning (SDL) through near-peer teaching using nesting among Phase I MBBS students. The findings demonstrated a statistically significant improvement in learning outcomes among students exposed to SDL through near-peer teaching by nesting compared

with those undergoing conventional SDL. In addition, students reported high levels of satisfaction, engagement, motivation and perceived improvement in understanding of the topic.

The improved learning gain observed in the intervention group may be explained by the educational advantages of near-peer teaching.

Near-peer students, being closer to learners in their level of training, may possess greater cognitive and social congruence with junior students. This enables them to communicate concepts in a manner that is more relatable and approachable, facilitating active participation, discussion, and clarification of doubts. Such interactions may create a supportive learning environment that enhances understanding and promotes deeper learning.

Another important feature of the intervention was the incorporation of nesting, wherein relevant higher-phase objectives were integrated into SDL sessions. This approach may have increased student interest and engagement by highlighting the clinical relevance of basic science concepts. Exposure to higher-phase perspectives may also have facilitated better integration of knowledge and encouraged students to appreciate the application of Biochemistry in clinical practice.

The positive perception expressed by students further supports the effectiveness of the intervention. The majority of participants reported improved conceptual understanding, increased motivation for self-learning, enhanced critical thinking and better retention of knowledge. Open-ended feedback revealed that interaction with near-peers, discussion-based learning, sharing of study resources and effective doubt-solving were among the most valued aspects of the sessions. These findings suggest that SDL facilitated through near-peer teaching may provide a more engaging learning experience than conventional SDL alone.

The intervention also appeared to benefit the near-peer phase III students. Most students reported that participation in teaching sessions helped reinforce their own conceptual understanding and improve communication and teaching skills. This finding highlights the bidirectional nature of near-peer teaching, wherein both learners and tutors derive educational benefits from the process.

The findings of the present study are consistent with previous literature. **Choi et al** ⁴. reported that peer-to-peer learning within a self-directed

learning framework enhanced both learning efficiency and effectiveness. Similarly, **Chukwuere et al** ⁵. observed that self-directed and cooperative learning approaches promote learner autonomy, motivation, communication and critical thinking skills. **Pintér et al** ⁶. demonstrated that the involvement of near-peer educators significantly improved student performance in basic surgical skills training. **Rashid et al** ³. reported that students appreciated teaching by near-peer tutors and experienced greater confidence and improved understanding of subject matter. Likewise, **Tayler et al** ⁷ observed that near-peer tutors were perceived as more approachable and receptive to student interaction because of increased cognitive and social congruence with learners. These findings collectively support the effectiveness of near-peer teaching as a valuable educational strategy in medical education.

The present study also aligns with the principles of competency-based medical education (CBME), which emphasize learner-centered approaches, active participation, integration and application of knowledge. By introducing clinically relevant higher-phase objectives during SDL sessions, the nesting approach facilitated vertical integration of learning. Such integration may reinforce foundational knowledge, improve its clinical relevance, and contribute to the development of competent medical graduates capable of applying basic science concepts in clinical settings. A major strength of the present study was the integration of near-peer teaching and nesting within a structured SDL framework involving a large cohort of undergraduate medical students. The intervention was implemented in a real educational setting and evaluated using both objective assessment scores and participant feedback, providing a comprehensive evaluation of its effectiveness ^{8,9}.

However, the study has certain limitations. It was conducted at a single institution and utilized convenience sampling, which may limit the wider applicability of the findings. Furthermore, the study primarily assessed short-term learning outcomes and perceptions; long-term retention of knowledge was not evaluated. Future

multicentric studies with larger sample sizes and long-term follow-up are recommended to further explore the educational impact of this approach.

CONCLUSION

The present study demonstrated that self-directed learning facilitated through near-peer teaching by nesting significantly improved student performance and was well accepted by Phase I MBBS students. This approach enhanced student engagement, motivation, conceptual understanding, and perceived learning effectiveness. The integration of near-peer teaching with nesting appears to be a valuable educational strategy for strengthening self-directed learning in the Competency-Based Medical Education (CBME) curriculum. Such innovative teaching-learning methods may contribute to improved academic outcomes and foster the development of lifelong learning skills among medical students.

Overall takeaways that we got were, learners overwhelmingly endorsed the near-peer integrated approach through nesting for improving knowledge, critical thinking, interest,

retention, and future performance—and they wanted more sessions like it. With higher values on likert scale our study reflected stronger agreement and positive perception among the students. Our study also indicated strong student satisfaction and support for the integrated approach of peer-led SDL sessions. Hence integrated near-peer teaching approach through nesting into SDL may offer unique benefits that can enhance both the learning experience and patient care outcomes. The CBME curriculum's design ensures that the biochemistry competencies acquired in the first year are revisited and applied in clinical contexts during the final year. Therefore this vertical integration may reinforce learning and highlight the clinical relevance of foundational sciences, ultimately aiming to produce well-rounded and competent medical graduates ^{10,11}.

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