

Original Research Article

Effectiveness of Small Group Discussion, Seminar and Self-Directed Learning in Teaching Biochemistry at Tertiary Care Teaching Hospital, South India

Dr. Sajeevan K.C.¹, Dr. Shajee S. Nair², Dr. Rejitha Ramachandran³, Dr. Sujina C.M.⁴, Dr. V. Sindhu Priya K.⁵, Mr. Athil M.⁶, Ms. Fathima Hiba V.P.⁷, Mr. Rahul A.S.⁸

¹Professor & HOD, Department of Biochemistry, Government Medical College (GMC), Thrissur, Kerala, India.

²Professor & HOD, Department of Biochemistry, Government Medical College (GMC), Kozhikode, Kerala, India.

³Associate Professor, Department of Biochemistry, Government Medical College (GMC), Paripilly, Kollam, Kerala, India.

⁴Assistant Professor, Department of Community Medicine, Government Medical College (GMC), Manjeri, Kerala, India.

⁵Assistant Professor, Department of Biochemistry, Government Medical College (GMC), Manjeri, Kerala, India.

⁶ MBBS Student, Government Medical College (GMC), Manjeri, Kerala, India.

⁷MBBS Student, Government Medical College (GMC), Manjeri, Kerala, India.

⁸ MBBS Student, Government Medical College (GMC), Manjeri, Kerala, India.

Corresponding Author

Dr. Sajeevan K.C., Professor & HOD, Department of Biochemistry, Government Medical College (GMC), Thrissur, Kerala, India.

Received: 13-08-2026 Revised: 04-09-2026 Accepted: 19-10-2026 Published: 27-10-2026

ABSTRACT

Background: Competency-based medical education (CBME) emphasises learner-centred teaching-learning strategies that promote active participation, critical thinking, and lifelong learning. Small-group discussion (SGD), seminar, and self-directed learning (SDL) are commonly employed approaches in undergraduate medical education; however, comparative evidence regarding their effectiveness in biochemistry remains limited.

Methods: A comparative study was conducted among 110 Phase I MBBS students of the 2023 batch at Government Medical College, Manjeri, from March to September 2024. Three biochemistry topics—calcium, iron, and copper metabolism—were taught using SGD, seminar, and SDL in a rotational arrangement across three student batches. Knowledge acquisition was assessed using pre-tests and post-tests. Student perceptions were evaluated using a ten-item questionnaire with a 0-10 rating scale.

Results: The median pre-test score was 5 for all three methods, with no significant difference between them ($p = 0.360$). Median post-test scores were 8 for SGD, 8 for seminar, and 9 for SDL; however, the difference was not statistically significant ($p = 0.461$). SDL received higher ratings for coverage of learning objectives, clarity of concepts, emphasis on important aspects, logical organisation, examination-note preparation, and motivation for further reading, critical thinking, and interest in the subject.

Conclusions: Self-directed learning was the most preferred method and received higher student-perception ratings across most educational domains. However, knowledge outcomes did not differ significantly among self-directed learning, small-group discussion, and seminar. All three methods can therefore be incorporated into undergraduate biochemistry teaching, with self-directed learning offering an advantage in learner acceptability and perceived educational value.

Keywords: Competency-based medical education; Biochemistry; Medical education; Self-directed learning; Small-group discussion; Seminar; Undergraduate medical students.

INTRODUCTION

Small group learning has gained popularity in medical education, fostering student engagement and enhancing the learning process. The characteristic feature of small group learning is active student involvement and task-oriented objectives. The advent of Competency-based medical education (CBME) in India implemented by the National medical council (NMC) in the academic year 2019 ushered in the onset of a transformative era fundamentally distinct from traditional medical education.^[1] The core objective of the updated curriculum is to address the expanding disparity between societal health needs and the education delivered.^[2] Consequently, CBME shifts away from time-based training, emphasizing a transition from teacher-centred to learner-centred educational methodologies.^[3] The successful execution of this goal meant a substantial shift in teaching-learning (TL) and assessment methods focussing more on knowledge acquisition. For more than 20 years didactic lectures were the most used and favoured medium of learning.^[4] However, current curriculum dictates lectures should not exceed one-third of the total schedule.^[5]

Collaborative or cooperative learning is widely applied in educational settings and it is often seen as a valuable learning condition by educators. Engaging in reflective activities in a group, in which individuals verbalise explanations and evaluate problems and solutions, has been shown to be beneficial for learning. For both teachers and students, it is important to know which learning strategies are most effective, as well as how individual differences may affect learning.^[6]

Small group teaching is distinguished by the active participation of learners throughout the entire learning process. It emphasizes well-defined task orientation, setting specific and attainable objectives within a designated timeframe and encourages reflection based on experiential and deep learning.^[7] Some illustrative methods of small group teaching encompass small group discussions, self-directed learning, and interactive seminars.

Small-group discussion (SGD) involves active student engagement, requiring participants to collaborate as partners in the teaching-learning process. Through interaction, discussion and idea-sharing with peers and instructors, students develop effective communication skills and recognize the

importance of teamwork within this educational context.^[8] This stands in contrast to Self-directed learning (SDL), where students take the initiative to independently plan, conduct and evaluate their own learning, emphasizing autonomy and individual freedom in the learning process.^[9] In the seminar teaching and learning (TL) process, students prepare and research the assigned topic in advance, subsequently sharing their acquired knowledge with both peers and instructors during the session. Seminars offer a unique advantage as they may accommodate a larger number of students compared to SGD or SDL.^[10]

Previous studies in biochemistry and other medical disciplines have reported improved learner performance and favourable perceptions following SDL, seminar-based learning, and other small-group interventions. However, much of this literature has evaluated a single teaching-learning method, often using before-and-after assessment or perception-based outcomes. Direct comparisons of SGD, seminar, and SDL conducted within the same learner cohort, curricular context, topic area, and assessment framework remain limited. Consequently, educators have insufficient evidence to guide the selection of an appropriate small-group method for specific biochemistry learning objectives and local institutional constraints.^[11,12] Therefore, this study aimed to compare the effectiveness of small-group discussion, seminar, and self-directed learning in teaching biochemistry among undergraduate medical students at Government Medical College, Manjeri. The study also aimed to explore students' perceptions of these approaches, where applicable.

Objectives

1. To analyse the effectiveness of teaching – learning methods in acquiring knowledge among regular batch phase-1 students.
2. To assess the perceptions and preferences regarding various small group learning methods.

MATERIALS AND METHODS

Study Setting

Government Medical College, Manjeri.

Study Design

Comparative study.

Study Period

March 2024 to September 2024.

Study Population & Sample Size:

110 MBBS students at Government Medical College, Manjeri.

Inclusion Criteria

Phase-1 MBBS students admitted in the 2023 batch at Government Medical College, Manjeri were included in the study.

Exclusion Criteria

Students who did not provide informed consent and those students are absent on the particular day of study were excluded from participating in the study

Detailed Methodology

This comparative study has been done to analyse effectiveness of different small group methods and to assess the perceptions of medical students on these small group methods. The three small group learning methods studied in this research work were small group discussion, seminar, and self-directed learning.

The 2023 batch MBBS students at government medical college, Manjeri, were categorized into three groups: A, B, and C. In the small group discussion learning method, each batch was divided into five groups, with each group consisting of 7-8 students. Each group was assigned different learning objectives related to the topic. The students within each group discussed these objectives, without teacher interference. Following the session, one member from each group was invited to present the learning objectives. Faculty members then clarified any doubts that arose during the discussion.

A seminar is a lecture or presentation delivered to an audience on a specific topic. The learning objectives for the topics were sent to five students of the batches in advance. The principal investigator should have in-depth knowledge about the topics and guide the seminar in a fruitful manner. The seminar commenced with an introductory speech by the principal investigator, justifying the topic selection by emphasizing its relevance in medical education. Following the introductory speech, the chairman invited the students to present their topics. After a brief presentation of each topic, the audience had the opportunity to ask questions to clarify any ambiguous areas. Participants actively engaged to make the seminar lively and interesting. The seminar sessions concluded after the presentations of all short topics and their discussions. Each

presenter was allocated a 10-minute time slot and the total duration of the seminar is 1 hour and 30 minutes.

Self-directed learning is a process wherein individuals, either independently or with assistance, take the initiative to diagnose their learning needs, formulate goals, identify resources for learning and choose and implement appropriate learning strategies. The learning objectives for the topics has been provided one week before the self-directed learning session and students are expected to take the initiative in setting goals and gathering resource materials. The principal investigator provided instructions on preparing notes for understanding the topics, while the faculty guides the Teaching-Learning processes. Students prepared their notes within a designated time of one hour and 30 minutes. Subsequently, students were randomly selected to present all the learning objectives of the topics. During the discussion, faculty members had clarified any doubts raised by the students.

The topics covered in this study were, calcium, copper, and iron metabolism. The 2023 batch students were divided into three batches, designated as A, B, and C. In the first week, calcium metabolism was discussed through a seminar for C batch, a group discussion for A batch, and self-directed learning for B batch. In the second week, the topic iron metabolism was dealt, with self-directed learning for C batch, a seminar for A batch, and a group discussion for B batch. In the third week, copper metabolism was covered through a group discussion for C batch, self-directed learning for A batch, and a seminar for B batch. To assess knowledge gain after different small group teaching methods, pre-tests and post-tests was administered. Data regarding the perception was collected using a questionnaire, employing a Likert scale ranging from 0 to 10, with 0 indicating the least favourable response and 10 being the most favourable. The surveys, consisting of ten statements, were analysed to address the research questions.

Funding Agency

Self

Data Analysis

Data Analysis was done in SPSS version 25. Univariate data was expressed in frequencies and percentage. The pre, Post-test and student's feedback scores for three methods of small group learning were tested for normality

using Kolmogorov -Smirnov test. The differences in results among the three teaching methods were analysed using Friedman test and if it was found significant then subgroup analysis was done using Dunn –Bonferroni Post-Hoc test. The test of significance was fixed at 0.05 (P value)

RESULTS

The pre-test and post-test scores were analysed using Friedman's test. There was no significant difference among the three groups in either the pre-test or post-test scores. (Table 1)

	Small group discussion	Seminar	Self-directed learning	Friedman P Value
Pre-Test score Median (IQR)	5(2.25)	5(3)	5(2)	0.360
Post Test Score Median (IQR)	8(3)	8(2)	9(2)	0.461

Table 1: Effectiveness of three small group learning methods using Pre and Post Test score

The 10 variables used for assessing perceptions of students about the three methods showed a significant difference between three groups using Friedman test (Table 2). The seven variables like covered all the learning objectives of the topic, described the concepts clearly, emphasized important aspects of the topics, helped students prepare notes for the examination, motivated students

for further references of the topic, provided the students opportunity for critical thinking, and aroused interest in the subject were better in the self-directed learning method. The variable, 'whether audio-visual methods used properly' was better in Seminar method. The median score was similar for the variables 'described the contents in logical sequence' and 'was the session interactive' in SGD and SDL.

Variable	Small group discussion Median (IQR)	Seminar Median (IQR)	Self-directed learning Median (IQR)	Friedman P Value
Covered all the learning objectives of the topic	8(7-9)	8(6-9)	9(8-10)	< 0.000
Described the concept very clearly	7(6-8)	7(6-9)	8.50(7-9)	< 0.000
Emphasized important aspects of the topic	8(7-9)	7.5(6-9)	8.50(7-9)	< 0.000
Described the contents in a logical sequence	8(6-8)	7(5-8)	8(7-9)	< 0.000
Helped students to prepare notes for examination	8(6-9)	5(3-8)	10(8-10)	< 0.000
Was session interactive	7(5-8)	6(4-8)	7(5-9)	< 0.000
Motivated the students for further references of the topics	7(5-8)	5(3-7)	8(6-9)	< 0.000
Provided the students opportunity to develop critical thinking	7(5-8)	5(4-7)	8(6-9)	< 0.000
Aroused interest in the subject	7(5-8)	5.50(4-8)	8(6-9)	< 0.000
Used audio visual aids properly	5(2-8)	8(6-9)	7(3.75-8)	< 0.000

Table 2: Comparative analysis of students' Perceptions using 10 variables among three groups

Dunn–Bonferroni post-hoc tests showed that students rated self-directed learning (SDL) significantly higher than both small-group discussion (SGD) and seminars for coverage of learning objectives, clarity of concepts, emphasis of important points and logical organisation of content (all $P < 0.001$ for SDL vs SGD and SDL vs Seminar). In contrast, SGD was rated significantly higher than seminars for helping students prepare examination notes, motivating further reading, arousing interest, and promoting critical

thinking ($P < 0.01$), while SDL also scored higher than seminars on these domains ($P < 0.001$) and higher than SGD for some items such as logical sequencing and exam-note preparation ($P < 0.05$). For interactivity, both SGD and SDL obtained significantly higher ranks than seminars ($P < 0.001$), whereas seminars and SDL had higher median scores than SGD for the appropriate use of audio-visual aids ($P < 0.001$ for Seminar vs SGD; $P < 0.05$ for SDL vs SGD; Table 3 and 4)

	Covered all the learning objectives of the topic		Described the concept very clearly		Emphasized important aspects of the topic		Described the contents in a logical sequence		Helped students to prepare notes for examination	
Groups	Mean diff #	P value	Mean diff	P value	Mean diff	P value	Mean diff	P value	Mean diff	P value
SGD Vs Seminar	-0.009	1.000	-0.073	1.000	0.227	0.276	0.277	0.119	0.773	0.000
SGD Vs SDL	-0.523	0.000	-0.0718	0.000	-0.364	0.000	-0.441	0.003	-0.405	0.008
Seminar Vs SDL	-0.514	0.000	-0.645	0.000	-0.591	0.000	-0.718	0.000	-1.177	0.000

Table 3: Post -Hoc pair wise comparison of student's perceptions

Difference in mean rank from post-hoc Dunn test after friedman; positive value indicates higher rank for the first-named method and negative value indicate higher rank for second method

	Was methods interactive		Motivated the students for further references of the topics		Provided the students to develop critical thinking		Aroused interest in the subject		Used audio visual aids properly	
Groups	Mean diff	P value	Mean diff	P value	Mean diff	P value	Mean diff	P value	Mean diff	P value
SGD Vs Seminar	0.491	0.001	0.409	0.007	0.377	0.015	0.327	0.046	-0.623	0.000
SGD Vs SDL	-0.027	1.000	-0.477	0.001	-0.582	0.000	-0.464	0.002	-0.345	0.031
Seminar Vs SDL	-0.518	0.000	-0.886	0.000	-0.959	0.000	-0.791	0.000	0.277	0.119

Table 4

Majority of Student's preferred method of small group teaching – learning was Self-

directed learning 81 in number (73.6%). SGD and Seminar were 11(10%) and 10 (9.1%).

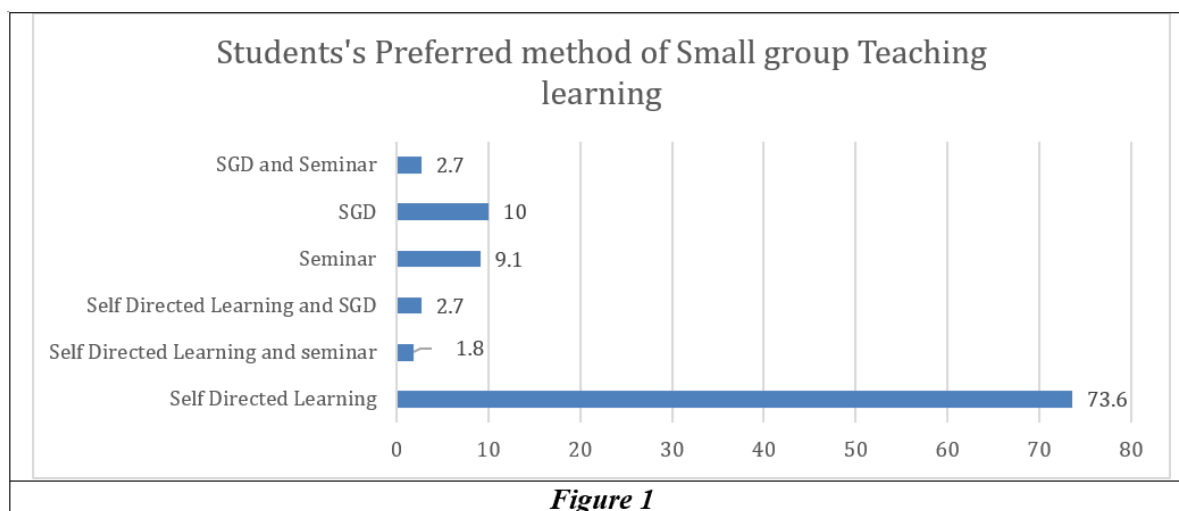


Figure 1

DISCUSSION

Medical education is a dynamic, ever-evolving process that needs to be periodically improved. Small group learning (SGL) techniques have been added to CBME as a complement to traditional teaching approaches as part of this advancement. With this amendment, the

National medical council hopes to generate Indian medical graduates who are lifelong learners capable of teamwork. The term "small-group learning methods" generally refers to a broad category of active, inductive, student-centred instructional approaches that enable learners in small groups to use social and

effective communication skills to work cooperatively and collaboratively with other group members in a team-based setting.^[13]

This study compared efficiency of three SGL methods-SGD, SDL, and seminar to teach biochemistry, a phase 1 subject, at our institution. According to an extensive review of the literature, our work is the first of its kind on pedagogical research in undergraduate medical education. There is a lack of data comparing the efficacy of these three small group learning approaches in our nation's medical education.

Following a thorough examination of our data, SDL was shown to be the most popular option, with over 70% of students choosing it above SGD and seminar. Although students acknowledged that seminar learning had an advantage in using audiovisual aids, SDL was the approach that assisted students in all other areas, including the development of critical thinking.

SDL does carry the distinct advantage of being learner directed with self-regulated learning methodologies implemented reflection, as evidenced in our study's results. Unfortunately, the lack of standardized instruments to gauge competency or learning outcomes makes SDL evaluation extremely difficult.^[14]

Patil et al. found similar results when comparing SDL and SGD in their study of perceptions and challenges among students with the new CBME curriculum. While only 67% of students agreed that SGD would boost their understanding and interest in a particular subject, 69% of students preferred SDL, which encouraged self-motivation and creativity.^[15]

According to Shilpa et al, 50% students regarded SGD and SDL to be equally beneficial. However, the study's researchers discovered that a lack of infrastructure, resources, people, or training made implementation challenging.^[16] Interestingly, conflicting result was obtained in a study done by Majeed et al in which only less than 40% students agreed that SDL and SGD are both helpful. The students noted that SDL does not impart enough confidence in students to outline the topic properly.^[17] In a study by Ilyas et al., 85% of students believed that SGD was helpful, whereas only 65% of students felt the same way with SDL.^[18]

This disparity in the findings about SDL could be partially attributed to the students' lack of preparation and to sessions in which they are expected to learn a topic alone. Well-designed self-directed learning (SDL) sessions

have the potential to change this by guiding students through a topic at their own speed and learning style while providing assistance by a facilitator.^[19] In addition, as the era of online education continues to evolve especially with the advent of Artificial Intelligence (AI), SDL can prove to be a crucial component of undergraduate medical education.^[20]

Despite a thorough review of the literature, no studies comparing seminar with SGD or SDL were found. Seminars do have a few noteworthy advantages over the same. As demonstrated by our study, seminars give students the chance to employ audiovisual resources, which helps to reinforce the subject. Students can take the initiative to research the subject, locate supporting materials and collaborate with peers to share knowledge points during the seminar teaching technique process. However, it does increase the learning burden.

Seven years have passed since the introduction of CBME in Indian medical education. This original study comparing the different TL methods highlights the necessity to reevaluate and redesign the curriculum with the required adjustments. This study carries the added advantage of aiding the teaching faculty to improve the TL methods in their respective institution.

CONCLUSIONS

Students rated Self-directed learning as their preferred method of learning. The knowledge gain was higher for self-directed learning but it was not statically significant. The seven variables like covered all the learning objectives of the topic, described the concepts clearly, emphasized important aspects of the topics, helped students prepare notes for the examination, motivated students for further references of the topic, provided the students opportunity for critical thinking, and aroused interest in the subject were better in the self-directed learning method. The variable, 'whether audio-visual methods used properly was better in Seminar method. The median score was similar for the variables 'described the contents in logical sequence' and 'was the session interactive' in SGD and SDL.

REFERENCES

1. Medical Council of India, Competency based undergraduate curriculum for the Indian Medical Graduate, 2018. Vol.1.

2. Shah N, Desai C, Jorwekar G, et al. Competency-based medical education: An overview and application in pharmacology. *Indian Journal of Pharmacology* 2016;48(Suppl 1):S5-9.
3. Frank JR, Mungroo R, Ahmad Y, et al. Toward a definition of competency-based education in medicine: a systematic review of published definitions. *Med Teach* 2010;32:631-7.
4. Nimesh A, Mehndiratta M, Kar R, et al. Teaching aids in medical education: an integrated approach over conventional methods. *Indian J Med Biochem* 2021;25(3):113-7.
5. Sharma R, Bakshi H, Kumar P. Competency-Based Undergraduate Curriculum: A Critical View. *Indian J Community Med* 2019;44(2):77-80.
6. Stenlund T, Jönsson FU, Jonsson B. Group discussions and test-enhanced learning: individual learning outcomes and personality characteristics. *Educ Psychol (Lond)* 2017;37(2):145-56.
7. Crosby J. Learning in small group: AMEE Medical Education Booklet No 8. *Med Teach* 1996;19:189-2002.
8. Roshni M, Rahim A. Small group discussions as an effective teaching-learning methodology for learning the principles of family medicine among 2nd-year MBBS students. *Journal of Family Medicine and Primary Care* 2020;9(5):2248-52.
9. Taylor DC, Hamdy H. Adult learning theories: implications for learning and teaching in medical education: AMEE Guide No. 83. *Med Teach* 2013;35(11):e1561-72.
10. de Jong Z, van Nies JA, Peters SW, et al. Interactive seminars or small group tutorials in preclinical medical education: results of a randomized controlled trial. *BMC Med Educ* 2010;10:79.
11. Sivakumar J, Anitha G, Dhinesh G. Effect of students' seminar as a revision strategy in biochemistry among I MBBS students in a medical college in Tamil Nadu. *Asian Journal of Medical Sciences* 2024;15(10):110-14.
12. Devi P, Agrawal P, Nitu, et al. The effectiveness of self-directed learning (SDL) for teaching Biochemistry to first-year medical students. *International Journal Dental and Medical Sciences Research* 2021;3(3):19-24.
13. Padmanabhan P, Kowale AN. Current Medical Education-A Bird's Eye View. *Int J Clin Med Edu Res* 2024;3(1):1-8.
14. Patil JS, Latha S, Patil V, et al. Competency-based medical education: perception and challenges among students. *Journal of Datta Meghe Institute of Medical Sciences University* 2023;18(1):63-9.
15. Shilpa A, Archana BR, Lakshminarayana SA. Faculty experience during transition to new Competency Based Medical Education Curriculum-A nationwide survey from India. *SVU-International Journal of Medical Sciences* 2023;6(2):445-51.
16. Majeed M, Ashraf Z, Manzoor S, et al. Understanding the perception of medical students regarding the newly introduced competency based medical education (CBME) and identifying the challenges which hamper its proper implementation. *JK Practitioner* 2023;28(1-2):35-41.
17. Ilyas N, Farooq M, Awan ZL, et al. Knowledge and awareness of students towards large and small group teaching in students of Rawal Institute of Health Sciences, Islamabad, Pakistan. *Rawal Med J* 2021;46:695-7.
18. Harakuni S. Engaging a self-directed learning session: Myths and facts. *Indian Journal of Health Sciences and Biomedical Research (KLEU)* 2022;15(3):187-9.
19. Aulakh J, Wahab H, Richards C, et al. Self-directed learning versus traditional didactic learning in undergraduate medical education: a systemic review and meta-analysis. *BMC Medical Education* 2025;25(1):70.
20. Zeng HL, Chen DX, Li Q, et al. Effects of seminar teaching method versus lecture-based learning in medical education: a meta-analysis of randomized controlled trials. *Med Teach* 2020;42(12):1343-9.