

Effectiveness of Socratic Circles versus Traditional Self-directed Learning in Physiology among First Year MBBS Students: A Mixed Methods Study

NIRMALA ANAND¹, RAJESH SHENOY², SOFIA ANJUM³

ABSTRACT

Introduction: In phase I MBBS, for conceptual intensive subjects like physiology, Socratic Circles (SCs) offer a dialogue-based inquiry driven teaching learning strategy. They contrast the traditional didactic faculty-driven approaches followed for Self-Directed Learning (SDL). While evidence from western universities support the effectiveness of Socratic Circles (SC) in enhancing critical thinking and student engagement, its utility in Indian medical curricula is unexplored.

Aim: To compare the effectiveness of SCs versus the traditional didactic SDL in Physiology among first year MBBS students.

Materials and Methods: This mixed methods study was conducted in Department of Physiology, Kaher's Jawaharlal Nehru Medical College, Belgaum, Karnataka, India, from August to December 2024 among 200 Phase I MBBS students. Students were randomly allocated to Group A (SC, n=100) and Group B (SDL n=100) using odd and even roll numbers. A pretest for all 200 students assessed their baseline knowledge. Group A (SC) underwent a structured preparatory phase for three weeks where, students generated their own learning objectives as well as learning resources. This was followed by

three sessions, each session of three hours long SC session. This was followed by reflection, debriefing, and feedback. Group B underwent conventional faculty led SDL with assigned tasks. Identical post-tests were administered after the sessions. The quantitative data were statistically analysed using Student test which measured the learning gains. The qualitative data obtained from reflective journals were analysed thematically.

Results: The study cohort consisted of Phase-I MBBS (Batch 2023-24) students with a mean age of (19.1±0.7) years, comprising 98 females (49%) and 102 males (51%). Group A (SC) showed a significant improvement in post-test scores (7.1±1.91) compared to pretest (4.2±1.27; p-value=0.001), whereas Group B (Traditional SDL) did not showed a statistically significant improvement (pretest: 4±1.20; post-test: 5.5±1.12; p-value=0.80). Quality assessment scores were also significantly higher in the SC group (6.2±0.67) than in the traditional SDL group (3±0.71; p-value=0.004).

Conclusion: Socratic circles greatly improved learning outcomes, critical thinking quality, and student engagement. Positive student feedback strongly supported the approach, which promoted deeper understanding and enhanced student responses' clarity, accuracy, depth, and precision.

Keywords: Critical thinking, Learner centric teaching, Learning methods, Teaching methods

INTRODUCTION

Medical colleges worldwide are attempting learner centric teaching learning activities aimed at fostering lifelong learning, collaboration, and a shift towards SDL [1]. SDL engages the students in identifying their learning gaps, designing their own objectives and identify their own resources and implement solutions [2]. In the context of physiology, SDL can help students better understand complex biological systems and processes.

The Socratic method of questioning, named after the Greek philosopher Socrates whose disciplined dialogues were a pedagogical approach to achieve deeper levels of understanding. In this approach the faculty does not provide all the information to the students rather allows students to engage in a meaningful dialogue, analyses, criticise, and develop concepts [3]. According to Socrates, teaching is an exercise in assisting students in ceasing to rely on perceptual knowledge of the imperfect material world and encouraging them to introspection discover true knowledge through logic and reasoning rather than simply imparting knowledge from "teacher" to "student" [4,5]. SC has been used in many fields to enhance critical thinking, logical reasoning, communication skills, and learner autonomy [6]. Decades of research have proven that critical thinkers can present dispositions like flexibility, persistence, and willingness when faced with a range of tasks; they display meta-cognitive monitoring and a willingness to self- correct to seek long-

term consensus [7]. Beyond the development of critical thinking, contemporary educational philosophy emphasises both higher - order thinking processes and meta cognitive integrations skills [8].

Dewey J described critical thinking as reflective thinking and emphasised on thinking process as a core educational objective [9]. Regular use of critical-thinking tools enhances the structure and productivity of Socratic questioning, helping students recognise the importance of inquiry in learning [10]. Socratic questioning is increasingly integrated into healthcare and medical education curricula [11,12]. As a peer-assisted strategy, it enables students to justify content scientifically and collaboratively refine their understanding [13,14]. However, there is limited evidence on the structured use of SCs in Phase-1 MBBS physiology and is an underrepresented SDL approach [15]. Majority of research which has been done in Western educational contexts, with hardly many examples from Indian contexts that address learning diversity and cultural differences of Indian Medical graduates [16,17].

It is crucial to increase student's motivation to learn by involving them in meaningful teacher-student conversations and interactive, experience-based activities. Furthermore, since practicing medicine requires clinical reasoning and decision-making which in turn depend on developed critical thinking abilities, is crucial to develop critical thinking thoroughly and at an early phase of MBBS [15]. Enhancing student motivation through meaningful teacher student dialogue

and interactive is essential for critical thinking, clinical reasoning and decision making. SCs shall help scaffold analytical thinking, social skills [16,17] and address the gap of logistic constraints and active participation as a feasible strategy to enhance engagement and improve academic outcomes.

With this background, present study was conducted to compare the effectiveness of SCs a Novel Inquiry-Based Learning strategy using with conventional didactic SDL on learning outcomes in Physiology among Phase-I MBBS students.

MATERIALS AND METHODS

This was a mixed methods study, conducted as a part of SDL at Department of Physiology Kaher's Jawaharlal Nehru Medical College, Belgaum, Karnataka, India, over a duration of August 2024-December 2024. The study was approved by the Institutional Ethics Committee (IEC reference: MDC/JNMC IEC/342). Prior to enrolment, all students were briefed about the study objectives, procedures, and potential risks. Voluntary written informed consent was obtained from each participant. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki (2013).

Inclusion criteria: First-year MBBS students of the 2023-24 batch, aged 18 to 20 years were included in the study.

Exclusion criteria: Students who were absent for more than one session were excluded and subsequently were assigned to study groups for the intervention.

Sample size: The study enrolled all 200 students using purposive sampling from the Phase I MBBS batch 2023-24. This sample represented the total available class size and was feasible for implementing the intervention within the study period.

Data collection: In present study, 200 Phase I MBBS students were randomly allocated to Group A (SC, n=100) and Group B (Traditional SDL, n=100) using odd and even roll numbers.

Socratic Circles (SC) intervention: Group A Physiology topics from the must know domain were selected two weeks prior to the intervention. One hundred Phase I MBBS students allocated to the SCs group and were subdivided into 10 subgroup of 10 students each. Each sub group elected a group leader and a scribe. Pretest was conducted at the beginning of the sessions consisting of 10 questions of one mark each.

Preparatory phase: Students were engaged in three weeks structured preparation period involving independent study followed by collaborative group discussions. Each subgroup generated their own learning objectives and developed open ended, analytical questions aimed at conceptual integration. Group leaders co-ordinated with faculty for academic guidance and resource identification. To support inquiry, three one-hour faculty facilitated planning sessions were conducted.

Conduct of Socratic Circles (SC): Students were arranged in concentric outer and inner circles, ensuring equal participation through role rotation midway through the session.

Inner circle: Presented learning objectives, posed prepared questions, responded to peer questions and documented discussions using cornell notes.

Outer circle: Observed, recorded responses, provided feedback and raised clarifying questions.

Discussions were initiated with brief topic introduction by the inner circle followed by student generated probing questions to stimulate analytical reasoning and integration of physiological concepts. Faculty facilitated the session to maintain focus and depth without direct instruction.

Questioning strategy:

Four types of questions guided the inquiry process:

Exploratory questions: to understand baseline understanding;

Spontaneous questions: to aid dialogue;

Focused questions: to prevent deviation from learning objectives;

Scaffold text-based questions: requiring evidence from textbooks, flowcharts, or conceptual diagrams.

Two questions under each section making a total of eight questions were asked.

Debriefing, Reflection and Feedback; Outer Circle students provided peer feedback followed by individual self-reflection. Randomly selected students summarised key concepts and each subgroup submitted a reflection through journaling.

Assessment was conducted using structured learning sheets evaluated across seven dimensions of critical thinking, with a binary scoring (0=unsatisfactory and 1=satisfactory) for each question yielding a maximum score of 7 [Table/Fig-1]. A post-test of 10 marks was administered 10 minutes before session completion. The total duration of SC was three hours with role reversal at 90 minutes.

Criteria	0	1
Clarity	The description is considered out of scope	The description is highly relevant
Accuracy	The description does not match with existing scientific theories	The description does match with existing scientific theories
Logical flow	The description is illogical	The description is logical
Depth	The description contains only basics	The description contains insightful information
Breadth	The description has limited arguments	The description is broad enough to include all arguments
Precision	The description is not scientific	The description is scientific
Significance	The description does not include critical thinking elements	The description does include critical thinking elements

[Table/Fig-1]: Quality assessment of answers to Socratic questioning.

For Batch B conventional traditional format of SDL was conducted. A single faculty provided the topic for discussion. The students were provided with questions in the form of assignments to be completed. This was followed by a post-test of 10 marks on the topic. At the end of the session a closed ended prevalidated feedback questionnaire was filed by the students which was graded using a 3-point Likert Scale. This was followed by reflective journaling the transcripts of which were reviewed iteratively to identify. This was followed by a crossover of the batches with a washout period of three weeks between interventions. Three such SDL sessions were conducted at the end of four months.

STATISTICAL ANALYSIS

The data was entered into Microsoft Excel and analysed using IBM Statistical Package for the Social Sciences (SPSS) statistic version 31.0. Quantitative data are presented as mean±standard deviation. Differences between group means were assessed using the Student's t-test. Feedback responses were summarised as frequencies and percentages. Reflective journal responses were analysed qualitatively using thematic analysis participant quotation were anonymised using coded identifiers and are reported verbatim with the assistance of ATLAS.ti software.

RESULTS

In present study, MBBS Phase I students 2023-24 batch participated in the study. The mean age was 19.1±0.7 years. About 51% were males (n=102) and 49% were females (n=98). Students were equally allocated to the two study groups, with 100 (50%) in Group A (SC) and 100 (50%) in Group B (Traditional SDL).

Pre- and Post-test performance demonstrated that students in the SC group showed a statistically significant improvement in performance, with post-test scores significantly higher than pretest scores. In contrast, the traditional SDL group showed only a marginal increase from 4±1.20 to 5.5±1.12, which was not statistically

significant (p -value=0.8). Intergroup comparison using unpaired t test of post-test scores shows a statistical difference in the mean scores of the SC group (p -value=0.02) suggestive of higher learning gains in SC group [Table/Fig-2].

	Pretest	Post-test	p-value
Traditional SDL	4±1.20	5.5±1.12	0.8
Socratic Circle (SC)	4.2±1.27	7.1±1.91	0.001*
p-value	0.89	0.002*	

[Table/Fig-2]: Comparison of pre and post-test marks of traditional SDL and Socratic Circles (SC).

Quality assessment of answers to Socratic questioning showed that students in the SC group provided responses of higher quality compared to those in the traditional SDL group [Table/Fig-3].

	Quality assessment	p-value
Traditional SDL	3±0.71	0.004*
Socratic Circle (SC)	6.2±0.67	

[Table/Fig-3]: Quality assessment of students for Traditional SDL and Socratic Circles (SC).

A detailed analysis of individual quality assessment criteria using unpaired t -test indicated that the SC method led to significantly higher scores in clarity (p -value=0.04), accuracy (p -value=0.001), breadth (p -value=0.001) and precision (p -value=0.0046). However, no significant differences were observed between the groups for logical flow (p -value=0.634) and significance (p -value=0.18) [Table/Fig-4].

Criteria	Socratic Circle (SC)	Traditional SDL	p-value
Clarity	0.83±0.34	0.62±0.21	0.004*
Accuracy	0.87±0.91	0.65±0.3	0.001*
Logical flow	0.72±0.12	0.78±0.56	0.634
Depth	0.85±0.15	0.60±0.24	0.001*
Breadth	0.88±0.8	0.68±0.55	0.001*
Precision	0.82±0.10	0.63±0.32	0.0046*
Significance	0.78±0.34	0.74±0.6	0.18

[Table/Fig-4]: Quality assessment of students for traditional SDL and Socratic Circles (SC).

Student feedback also strongly favoured the SC approach. Most students reported that the method motivated them to prepare objectives {180 (90%)}, engage with pre-reading material {188 (94%)}, and identify resources collaboratively {188 (92%)}. In addition, {188 (94%)} felt it invoked curiosity and interest in the topic, while {178 (89%)} agreed it helped them organise content effectively. Furthermore, {182 (91%)} indicated that it improved their ability to present content sequentially and enhanced their understanding of underlying concepts [Table/Fig-5]. Overall, the SC method outperformed traditional SDL, and was positively received by students.

Questions	Agree (%) (Frequency)	Neutral (%) (Frequency)	Disagree (%) (Frequency)
I was motivated to prepare objectives of what I wanted to know about the topic	180 (90)	20 (10)	----
I was motivated to read the pre reading material along with my peers	188 (94)	12 (06)	----
Along with my peers, identifying my own resources helped me	184 (92)	16 (08)	-----
It invoked curiosity and interest in the topic	188 (94)	12 (06)	----
It helped me organise my content and plan accordingly.	178 (89)	22 (11)	----
It helped me present my content in a sequential manner and understand the basis for it.	182 (91)	18 (09)	----

It improved my presentation and communication skills.	174 (87)	26 (13)	---
Debriefing and reflecting helped in consolidating information.	174 (87)	26 (13)	----

[Table/Fig-5]: Feedback responses of students for Socratic Circles (SC).

The following section discusses the excerpts from reflective journaling of the [Table/Fig-6,7].

Themes	Subthemes	Quotes
Conceptual understanding	Increased conceptual knowledge pathway integration and mechanistic explanation"	Discussing renal and neural mechanisms helped me see why BP changes occur, not just memorise them"
Critical thinking and reasoning	Question-driven analysis and argumentation	"The probing questions forced me to justify answers using concepts, not guesswork."
Use of resources	Textual evidence; diagrams and flowcharts	"I used flowcharts and textbook passages to support my arguments."
Communication skills	Proficiency and speaking with assurance and paying attention active listening	"Switching circles made me listen better and explain my ideas clearly."
Peer collaboration	Planning as a group and exchanging resources	Preparing objectives with peers made the session efficient and enjoyable.
Organisation and sequential thinking	Cornell notes; structured presentation	"The Cornell notes made it easier for me to organise my ideas and make revisions."

[Table/Fig-6]: Reflective Journaling: Common themes which emerged during the journaling aligning with the process of standard qualitative analysis frameworks (Braun & Clarke).

S. No.	Themes
1.	Depth of learning and critical thinking a. Students developed active learning and linking of concepts b. Exposure to multiple perspectives improved conceptual understanding c. Improved synthesis, evaluation, reflection and argumentation
2.	Communication and social skills a) Ability to articulate ideas clearly and logically b) Active listening c) Asking spontaneous, probing questions supported dialogue
3.	Shared decision making and goal setting a) Ability to listen to others, respond and build on others idea b) Starting with small ideas and building a final goal
4.	Learner engagement and motivation a) Dynamic conversation creates active engagement b) Students feel a sense of ownership and contribution c) Sense of inquiry promoted deeper links
5.	Learning community based on social learning and peer support a) Peer discussion enhances conceptual clarity b) Shared learning responsibility and mutual support c) Sense of belonging to the learning group
6.	Emotional and Psychological safety in learning. a) Reduced fear of judgement through structured learning b) Improvement in confidence through participation c) Encouraging atmosphere leading to active learning
7.	Development of self-regulated learning. a) Connected physiological mechanism to develop reasoning skills b) Improvement in memorisation better than rote learning c) Develop skills which will help in future
8.	Challenges and Barriers a) Some students hesitated and some dominated b) Required more time than traditional SDL c) Required some training in question formulation.

[Table/Fig-7]: Major themes and sub themes emergent from reflective journaling summary related to the Socratic Circle (SC) format.

Theme No. 1- Depth of Learning and Critical Thinking

"Earlier I use to memorising like I did in my 12th grade classes, but now I was try to understand how concepts are related to each other"- S3.

"Hearing different opinions from different students made me think about the same question many ways"-S12.

"The probing questions as well as questions asked by my peer pushed me to study the topic more deeply-S8".

From the above it was clear that SCs promoted them to think critically rather than just depend on recall. The dialogue format exposed students to various viewpoints broadening their analytical reasoning.

Theme No. 2- Communication and Social Skills

"At first I was scared to speak but my friends helped me put my thought into words"- S10

"I learnt how to ask meaningful questions instead of just bookish questions"- S2

"Listening to others and then responding improved my communication skills"- S14

Students reported SC as a safe place where they could hone their confidence and competence and contribute towards academic communication. Some students experienced that the technique nurtures the ability to express verbally and overcome hesitation.

Theme No 3- Shared Decision Making and Goal Setting

"I felt more involved as together we decided which topic needs further clarity"- S5

"For the first time, our discussion goal mattered not only what the teacher planned"- S18

"Before any SC session, we jointly decided our learning objectives as a group"- S13

Students identify goal setting through partnerships and it promotes their professional identity. Many opined that reaching a goal requires collaborative efforts. Development of mutual respect was utmost for shared decision making.

Theme No 4-Learner Motivation and Engagement

"The discussions kept me focused because I wanted to contribute meaningful each time"- S1

"I looked forward to these sessions as it was more enjoyable reading together"- S15

"I prepared more seriously because I did not want to let my group down"- S8

The SCs promoted their engagement and motivation in the learning process. The participatory nature of the format kept the students mentally and emotionally invested.

Theme No 5- Learning Community based on Social Learning and Peer Support

"I felt like I belong to a group and was not studying alone"- S7

"I learnt how others framed the arguments and learned to improvise"- S9

"When I got confused, my classmates helped me think instead of just giving answers"- S16

The emergence of the theme of learning community, social learning through peer support shows a shift from teacher centric towards a student driven knowledge construction. Students described the space as a place where learning became shared, collaborative, and social aligning with Bandura's social learning theory.

Theme No 6- Emotional and Psychological Safety in Learning

"No one laughed at my ideas so I became more confident"- S20

"No one judged the quality of answers so was without fear"- S11

"I did not feel the pressure of presenting the most perfect answer, my peers helped me participate in the discussion"- S10

"The more sessions we had more connected we felt which never happens in normal classes"- S4

Unlike a traditional SDL, SCs felt safer and more non-judgemental where they could express uncertainties and explore alternative viewpoints. The sense of safety closely aligns with Edmondson's

framework of psychological safety which supports the fact that team's function on mutual respect.

Theme No 7- Development of Self-regulated Learning

"My peers helped me plan my time better than just randomly at the last moment"- S13

"I built small goals initially for the session and then decided the outcomes I wanted to attain "- S11

"Listening to others I understood the areas where I was lacking so I could focus more on it"- S1

"I felt responsible for my own learning rather than waiting for the teacher to teach" - S9

"I changed my whole study strategy; I now focus on understanding the concept before I read further"- S18

"After each session, I reflected on how I answered and how I could improve next time"- S6

The theme of self-regulated learning as a part as a part of SCs reveals how intentional and reflective behaviours promote active learning. Student reflections show growth across core SRL domains described by Zimmerman.

Theme No 8- Challenges and Barriers

"I found it difficult initially as I was used to study from lectures not from discussions"- S13

"Switching from memorisation to analysing was difficult"- S19

"Initially, I found it difficult as I was not knowing what kind of preparation is required" - S16

"Balancing this level of preparation with other subjects was difficult"- S12

"The circle felt fast and even if one student was not prepared it affected the whole group"- S17

The challenges reflect both individual learner factors as well as structural aspects of the format highlighting the complexities of transitioning from traditional teacher centered models to a dialogue based student centric learning.

DISCUSSION

The phase I MBBS students who participated in the present study included (102, 51%) males and (98, 49%) females with a mean age of (19.1±0.7) years. Present study was conducted with the aim of creating a collaborative heutagogical enquiry-based classroom where critical thinking is supported as a part of SDL in physiology in MBBS Phase I. The results of the present study indicate more than 90% of the students felt motivated by the instructional style and expressed greater satisfaction in completing prereading assignments. Additionally, 92% of the students felt finding their own reading resources with the help of their peer helped them remain motivated. Planning their own resources helped them gain ownership of their learning and collaborating with their peers helped them gain access to wider resources, shared knowledge and enriched their experience. Based on the quality assessment criteria like content clarity and accuracy, depth and breadth, precision of SCs discussion were qualitatively superior as compared to the traditional SDL conducted at the department. The comparison of post-test scores with the pretest scores of Batch A (SC) shows a statistical improvement in the scores following the implementation of this innovative teaching learning technique.

Furthermore, comparison of the post-test scores between both the Group A and Group B indicated that students exposed to SCs achieved statistical higher improvement as compared to those in the traditional SDL group, reinforcing the effectiveness of SC as a teaching learning strategy. The faculty plays a pivotal role in assessing a student's prior understanding and directing their attention towards concepts that may have been overlooked. Around 91%

of the students felt that SCs helped them present their content in a sequential manner. The intent of Socratic inquiry extends beyond mere elicitation of answers to more abstract conceptualisation; it encourages critical thinking in students and promotes justification, integration of diverse perspectives. Ultimately, SCs promote better communication skills, social skills, reading, comprehension and conceptual clarity among students contributing to an effective and enriched learning environment. SCs facilitate better understanding hence provides a better alternative to an already overburdened by better faculty at medical colleges [18]. The informal exchanges which occur in the inner circle along with contributions from the outer circle, along with inputs from the faculty help towards a high-quality discourse. Students explore concepts and support them with evidence, resulting in a more dynamic presentation to produce a more dialectical classroom atmosphere [19]. Peer driven accountability aligns with the social cognitive model demonstrating that learning behaviours are driven by collaborative norms. The follow-up questions are of crucial in Socratic questioning as they evoke critical thinking and reasoning demanding a great deal of commitment and teaches them to be open minded to others perspectives and alternative compelling hypotheses while pitching their own counter arguments without giving up when faced with difficulty [20].

Reaching a consensus requires looking at facts from all the angles, which help students aim for perfection. Even the shy students learn to articulate their thoughts, they learn to communicate which is the key principle highlighted by Indian Medical Graduate (IMG) [21].

SCs involve engagement of both inner and outer circle students promoting active learning and by reflecting on what they have learnt they can help goal setting [22]. Students found the SC as thought-provoking and appreciated the structured questioning, which help them connect physiological concept rather than memorising facts. Themes from their reflections suggest that this approach enhanced higher - order cognitive and meta cognitive skills compared to traditional SDL. Some challenges included the extra time needed for reading and preparation, as well as the impact of uneven group participation. Overall SCs foster a more interactive learning environment that promotes deeper understanding, critical thinking and communication skills.

Limitation(s)

The study was limited to a single batch of Phase I MBBS which may limit generalisation. The authors intend to repeat the same in the current cohort.

CONCLUSION(S)

The SCs resulted in significantly higher learning gains, improved analytical and reasoning skills and greater student engagement compared to the traditional SDL in physiology. The structured inquiry and peer dialogue fostered deeper conceptual understanding, communication skills, critical thinking indicating that SCs are active learner centric learning format and an effective alternative to passive

teacher led SDL in physiology. Future research should focus on long-term retention, multicentric application and integration of SCs across basic sciences.

REFERENCES

- [1] McDonald RE, Derby JM. Active learning to improve presentation skills: The use of Pecha Kucha in undergraduate sales management classes. *Mark Educ Rev*. 2015;25(1):21-25. Doi: 10.1080/10528008.2015.999593
- [2] Knowles MS. *Self-Directed Learning*. New York: Cambridge The Adult Education Co., 1975.
- [3] Ali Sulaiman MAHB. Application of teachers' knowledge of Socratic questioning in developing EFL critical thinking skills among Omani post-basic learners. *Arab World English J*. 2020;11(4):01-18.
- [4] Scott D. *Recollection and experience: Plato's theory of learning and its successors*. Cambridge, UK: Cambridge University Press; 2007.
- [5] Pekarsky D. Socratic teaching: A critical assessment. *J Moral Educ*. 1994;23(2):119-34. Doi: 10.1080/0305724940230202.
- [6] Halpern DF. *Thought and knowledge: An introduction to critical thinking*. 5th ed. New York: Psychology Press; 2013.
- [7] Nordin S, Yunus K. Exploring metacognitive awareness among teachers. *Int J Acad Res Progress Educ Dev*. 2020;9(2):462-72.
- [8] Dewey J. *How we think*. Boston: DC Heath & Co.; 1910
- [9] Elder L, Paul R. *Critical thinking: The art of Socratic questioning, part II*. *J Dev Educ*. 2007;31(2):32-33.
- [10] Wilberding E. *Socratic methods in the classroom: Encouraging critical thinking and problem solving through dialogue*. New York: Routledge; 2021.
- [11] Sanchez-Lara PA, Grand K, Haanpää MK, Curry CJ, Wang R, Ezgü F, et al. Thinking outside "the box": Case-based didactics for medical education and the instructional legacy of Dr John M. Graham, Jr. *Am J Med Genet A*. 2021;185(9):2636-45.
- [12] Thomas C, Goering CZ. Socratic circles in world history: Reflections on a year in dialogue. *Clear House J Educ Strateg Issues Ideas*. 2018;91(3):103-10. Doi: 10.1080/00098655.2017.1411132.
- [13] Brown AC. Classroom community and discourse: How argumentation emerges during a Socratic circle. *Dialogic Pedagogy J [Internet]*. 2016 Mar 22 [cited 2024 Jul 24];4:1-21. Available from: <https://dpj.pitt.edu/ojs/dpj1/article/view/160>.
- [14] Devine C. Socratic circles pedagogy: Dialogue about and demonstration of values. In: Lovat T, Toomey R, Clement N, Dally K, editors. *Second international research handbook on values education and student wellbeing*. Cham: Springer; 2023. p. 1053-69. Doi: 10.1007/978-3-031-24420-9_58.
- [15] Stoddard HA, O'Dell DV. Would socrates have actually used the "socratic method" for clinical teaching? *J Gen Intern Med*. 2016;31(9):1092-96. Doi: 10.1007/s11606-016-3722-2. Epub 2016 Apr 29. PMID: 27130623; PMCID: PMC4978680.
- [16] Oylar DR, Romanelli F. The fact of ignorance: Revisiting the Socratic method as a tool for teaching critical thinking. *Am J Pharm Educ*. 2014;78(7):144. Doi: 10.5688/ajpe787144. PMID: 25258449; PMCID: PMC4174386.
- [17] Ho YR, Chen BY, Li CM. Thinking more wisely: Using the Socratic method to develop critical thinking skills amongst healthcare students. *BMC Med Educ*. 2023;23(1):173. Doi: 10.1186/s12909-023-04134-2. PMID: 36941597; PMCID: PMC10026783.
- [18] Tofade T, Elsner J, Haines ST. Best practice strategies for effective use of questions as a teaching tool. *Am J Pharm Educ*. 2013;77(7):155. Doi: 10.5688/ajpe777155.
- [19] Persky AM, Medina MS, Castleberry AN. Developing critical thinking skills in pharmacy students. *Am J Pharm Educ*. 2019;83(2):7033. Doi: 10.5688/ajpe7033. PMID: 30962645; PMCID: PMC6448513.
- [20] Knezic D, Wubbels T, Elbers E, Hajer M. The Socratic dialogue and teacher education. *Teach Educ*. 2010;26(4):1104-11. Doi: 10.1016/j.tate.2009.11.006.
- [21] Paul R, Elder L. *Critical thinking: Intellectual standards essential to reasoning well within every domain of human thought, part two*. *J Dev Educ*. 2013;37(1):32-33.
- [22] Torabizadeh C, Homayuni L, Moattari M. Impacts of Socratic questioning on moral reasoning of nursing students. *Nurs Ethics*. 2018;25(2):174-85. Doi: 10.1177/0969733016667775.

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Physiology, KAHER'S JNMC, Belgaum, Karnataka, India.
2. Professor, Department of Neurosurgery, KAHER'S JNMC, Belgaum, Karnataka, India.
3. Postgraduate Student, Department of Physiology, Jawaharlal Nehru Medical College, Belagavi, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Rajesh Shenoy,
Professor, Department of Neurosurgery, KAHER'S JNMC, Belgaum, Karnataka, India.
E-mail: rajesh_cruz@yahoo.com

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Aug 24, 2025
- Manual Googling: Mar 30, 2026
- iThenticate Software: Apr 01, 2026 (1%)

ETYMOLOGY: Author Origin

EMENDATIONS: 8

Date of Submission: **Aug 23, 2025**
Date of Peer Review: **Nov 22, 2025**
Date of Acceptance: **Apr 03, 2026**
Date of Publishing: **Jun 01, 2026**