

ORIGINAL ARTICLE

Effectiveness of fishbowl method as an interactive teaching learning tool for phase II MBBS students in the microbiology department of a medical college in India: A prospective interventional study

Pratibha Sharma¹,
Amit Kumar Singh^{2,*}, Archana Dhok³, Amrita Sarkar⁴, Vandana Dewangan¹
1 Sri Balaji Institute of Medical Sciences, Raipur, Chattisgarh, India
2 Maharshi Vashishtha Autonomous State Medical College, Basti, India
3 Jawaharlal Nehru Medical College, Wardha, Maharashtra, India
4 Tomo Riba Institute of Health and Medical Sciences, Naharlagun, Arunachal Pradesh, India
* Maharshi Vashishtha Autonomous State Medical College, Basti, India
Tel: +9140225517
Email: dramitsingh.in@gmail.com

Background: This study aimed to evaluate the effectiveness of fishbowl method as an interactive teaching learning tool for phase II MBBS students in the microbiology department of a medical college in India.

Method: This prospective interventional study involved 110 MBBS 2nd professional students at Shri Balaji Institute of Medical Sciences, India. After a didactic lecture on enteric fever, students participated in a fishbowl activity, divided into closed and open sessions. Post-lecture and post-fishbowl assessments were conducted using 16 multiple-choice questions (MCQs) and a survey with Likert-scale and open-ended questions to gather feedback.

Results: The results showed a statistically significant improvement in students' scores after the fishbowl method ($p < 0.001$). The mean test scores post-lecture and post-fishbowl were 6.50 and 9.07, respectively. Students' feedback revealed strong agreement (30 - 41%) that the fishbowl method was interesting, improved critical thinking, and enhanced communication skills. The method was also found to increase interest, improve retention, and provide a clearer understanding of concepts.

Conclusion: The study demonstrates the effectiveness of the fishbowl method in enhancing students' understanding and retention of microbiology concepts, promoting academic excellence and interactive learning. It highlights the need for student-centered approaches and innovation in teaching practices to optimize learning outcomes and transform education.

Keywords: Fishbowl method, Interactive teaching learning tool, MBBS students, Didactic lecture, Medical education

فعالية أسلوب "حوض السمك" كأداة تعليمية تفاعلية لطلاب السنة الثانية من برنامج بكالوريوس الطب والجراحة في قسم الأحياء الدقيقة بإحدى الكليات الطبية في الهند: دراسة تدخلية مستقبلية

الخلفية: هدفت هذه الدراسة إلى تقييم فعالية أسلوب "حوض السمك" كأداة تعليمية تفاعلية لطلاب السنة الثانية من برنامج بكالوريوس الطب والجراحة في قسم الأحياء الدقيقة بإحدى الكليات الطبية في الهند.

الطريقة: شملت هذه الدراسة التدخلية المستقبلية ١١٠ طالب من طلاب السنة الثانية في برنامج بكالوريوس الطب والجراحة في معهد شري بالاجي للعلوم الطبية في الهند. بعد محاضرة نظرية حول حمى التيفوئيد، شارك الطلاب في نشاط "حوض السمك"، الذي قُسم إلى جلسات مغلقة ومفتوحة. أجريت تقييمات بعد المحاضرة وبعد نشاط "حوض السمك" باستخدام ١٦ سؤالاً من نوع الاختيار من متعدد، بالإضافة إلى استبيان يتضمن أسئلة بمقياس ليكرت وأسئلة مفتوحة لجمع الملاحظات. **النتائج:** أظهرت النتائج تحسناً ذا دلالة إحصائية في درجات الطلاب بعد تطبيق أسلوب "حوض السمك" ($p < 0.001$). بلغ متوسط درجات الاختبار بعد المحاضرة وبعد جلسة النقاش التفاعلي ٦.٥٠ و ٩.٠٧ على التوالي. وأظهرت آراء الطلاب اتفاقاً قوياً (٣٠-٤١٪) على أن أسلوب النقاش التفاعلي كان شيقاً، وحسّن التفكير النقدي، وعزز مهارات التواصل. كما وُجد أن هذا الأسلوب يزيد من الاهتمام، ويُحسّن الاستيعاب، ويوفر فهماً أوضح للمفاهيم.

الخلاصة: تظهر هذه الدراسة فعالية أسلوب النقاش التفاعلي في تعزيز فهم الطلاب واستيعابهم لمفاهيم علم الأحياء الدقيقة، ودعم التميز الأكاديمي والتعلم التفاعلي. كما تُسلط الضوء على الحاجة إلى مناهج تركز على الطالب، والابتكار في أساليب التدريس لتحسين مخرجات التعلم وتطوير التعليم.

الكلمات المفتاحية: أسلوب النقاش التفاعلي، أداة تعليمية تفاعلية، طلاب الطب، المحاضرة التقليدية، التعليم الطبي

ہندوستان میں میڈیکل کالج کے مائیکروبیولوجی ڈیپارٹمنٹ میں فیز MBBS II کے طلبہ کے لیے ایک انٹرایکٹو ٹیچنگ لرننگ ٹول کے طور پر فش باؤل کے طریقہ کار کی تاثیر: ایک ممکنہ مداخلتی مطالعہ

پس منظر: اس مطالعہ کا مقصد ہندوستان میں میڈیکل کالج کے شعبہ مائیکروبیولوجی میں فیز MBBS II کے طلبہ کے لیے ایک انٹرایکٹو ٹیچنگ لرننگ ٹول کے طور پر فش باؤل کے طریقہ کار کی تاثیر کا جائزہ لینا ہے۔

طریقہ: اس ممکنہ مداخلتی مطالعہ میں شری بالاجی انسٹی ٹیوٹ آف میڈیکل سائنسز، انڈیا میں ١١٠ MBBS 2nd پیشہ ور طلباء شامل تھے۔ آنتوں کے بخار پر ایک تدریسی لیکچر کے بعد، طلباء نے فش باؤل کی سرگرمی میں حصہ لیا، جسے بند اور کھلے سیشن میں تقسیم کیا گیا۔ لیکچر کے بعد اور فش باؤل کے بعد کے جائزے ١٦ کثیر انتخابی سوالات (MCQs) کا استعمال کرتے ہوئے کیے گئے اور رائے جمع کرنے کے لیے Likat-scale اور open-ended سوالات کے ساتھ ایک سروے کیا گیا۔

نتائج: نتائج نے فش باؤل طریقہ ($p < 0.001$) کے بعد طلباء کے اسکور میں شماریاتی طور پر نمایاں بہتری دکھائی۔ لیکچر کے بعد اور پوسٹ فش باؤل کے اوسط ٹیسٹ کے اسکور بالترتیب ٦.٥٠ اور ٩.٠٧ تھے۔ طلباء کے تاثرات نے مضبوط اتفاق (٣٠-٤١٪) ظاہر کیا کہ فش باؤل کا طریقہ دلچسپ تھا، تنقیدی سوچ کو بہتر بنایا، اور مواصلاتی مہارتوں میں اضافہ ہوا۔ یہ طریقہ دلچسپی بڑھانے، برقرار رکھنے کو بہتر بنانے اور تصورات کی واضح تفہیم فراہم کرنے کے لیے بھی پایا گیا۔

نتیجہ: یہ مطالعہ فش باؤل کے طریقہ کار کی تاثیر کو ظاہر کرتا ہے تاکہ طلباء کی مائیکروبیولوجی کے تصورات کی تفہیم اور اسے برقرار رکھا جاسکے، تعلیمی فضیلت اور انٹرایکٹو لرننگ کو فروغ دیا جائے۔ یہ سیکھنے کے نتائج کو بہتر بنانے اور تعلیم کو تبدیل کرنے کے لیے تدریسی طریقوں میں طالب علم پر مبنی نقطہ نظر اور جدت طرای کی ضرورت کو اجاگر کرتا ہے۔

کلیدی الفاظ: فش باؤل طریقہ، انٹرایکٹو ٹیچنگ لرننگ ٹول، ایم بی بی ایس طلباء، ڈیٹیکٹ لیکچر، میڈیکل ایجوکیشن

اثر بخشی روش فیش باؤل (fishbowl) به عنوان ابزار یادگیری تعاملی برای دانشجویان سال دوم MBBS در دپارتمان میکروبیولوژی یک دانشکده پزشکی در هند: یک مطالعه مداخله‌ای آینده‌نگر

زمینه و هدف: این مطالعه باهدف ارزیابی اثربخشی روش فیش باؤل به عنوان یک ابزار یادگیری تعاملی برای دانشجویان سال دوم دوره MBBS در بخش میکروبیولوژی یک دانشکده پزشکی در هند انجام شد.

روش: این مطالعه مداخله‌ای آینده‌نگر شامل ١١٠ دانشجوی سال دوم پزشکی (MBBS) در مؤسسه علوم پزشکی شری بالاجی هند بود. پس از برگزاری یک سخنرانی آموزشی درباره بیماری تب روده ای دانشجویان در یک فعالیت فیش باؤل شرکت کردند که شامل دو مرحله جلسه بسته و جلسه باز بود ارزیابی‌های پس از سخنرانی و پس از فعالیت فیش باؤل، از طریق ١٦ سؤال چهار گزینه‌ای (MCQ) و یک پرسشنامه شامل سوالات طیف لیکرت و سوالات باز (برای جمع‌آوری بازخورد) انجام شد.

یافته‌ها: نتایج نشان دهنده بهبود آماری معنی‌داری در نمرات دانشجویان پس از روش فیش باؤل بود ($p < 0.001$). میانگین نمرات آزمون پس از سخنرانی و پس از فیش باؤل به ترتیب ٦/٥٠ و ٩/٠٧ بود. بازخورد دانشجویان نشان داد که ٣٠ تا ٤١ درصد از آن‌ها به شدت موافق بودند که روش فیش باؤل جذاب و جالب است تفکر انتقادی را بهبود می‌بخشد و مهارت‌های ارتباطی را تقویت می‌کند همچنین مشخص شد که این روش باعث افزایش علاقه، بهبود حفظ مطالب و درک واضح‌تر از مفاهیم می‌شود.

نتیجه گیری: این مطالعه اثربخشی روش فیش باؤل را در افزایش درک و حفظ مفاهیم میکروبیولوژی توسط دانشجویان، ارتقای تعالی تحصیلی و یادگیری تعلیمی نشان می‌دهد این مطالعه بر نیاز به رویکردهای دانشجو محور و نوآوری در شیوه‌های تدریس برای بهینه‌سازی نتایج یادگیری و تحول آموزش تأکید می‌کند.

واژه های کلیدی: روش فیش باؤل، ابزار یادگیری تعاملی، دانشجویان MBBS، سخنرانی آموزشی، آموزش پزشکی

INTRODUCTION

Medical education has rapidly progressed and improved over the last decade. The global trend for rationalizing teaching-learning is gathering momentum toward a dynamic mindset instead of traditional didactic lectures (1). Quality teaching is an important factor, and it depends upon the curriculum, faculty expertise, and innovative teaching and learning methodologies. In the era of the information explosion, students are expected to master a large amount of academic load in a short duration, making the entire learning process painful (2).

Didactic lectures are the most frequently employed teaching method, and due to their passive nature, they fail to promote active engagement of students and opportunities for interaction and inquiry (3). The Competency-Based Medical Education (CBME) curriculum emphasized active learning strategies, such as Small Group Discussions (SGD), to help undergraduate medical students achieve desired competencies, enhance communication skills, and apply previous knowledge effectively (4, 5).

Microbiology as a subject requires the students to understand the correlation between infectious agents and disease by combining their cognitive knowledge, analytical skills, and evaluative thinking. This complex correlation is difficult to achieve through didactic lectures, and innovative and interactive methods are necessary. The fishbowl method is an effective conversational approach developed for this purpose. In this technique, a small inner circle of students actively discusses a topic while an outer circle of students observes and reflects. This method limits the content of the discussion by fencing and framing it with pre-posted questions, guiding students from simple recall to complex clinical evaluation and simultaneously enhancing the communication skill and peer-to-peer learning (6).

We hypothesized that the fishbowl method is an interactive teaching-learning tool which can significantly enhance the understanding of clinical concepts in Microbiology among Phase II MBBS students compared to traditional didactic lectures, and is perceived positively by students as an effective learning approach. Thus, this study aimed to evaluate the effectiveness of fishbowl method as interactive teaching learning tool and to obtain the student perception towards this new learning tool.

METHODS

Study design

This was a prospective single-group pre- and post-test quasi-experimental study.

Participants

All 110 Phase II MBBS students of Shri Balaji

Institute of Medical Sciences, Raipur, Chhattisgarh, India who were willing and gave their consent were included.

Interventions

Following a brief orientation session, all MBBS Phase II students attended a didactic lecture on enteric fever. After the lecture, a pre-intervention assessment was conducted via Google Forms using 16 multiple-choice questions (MCQs). Students were then briefed on the upcoming fishbowl session. In preparation for the activity, relevant subtopics were identified and prepared. The fishbowl activity was subsequently conducted over the next three consecutive days during the students' practical classes. A total of 110 students, divided into three batches (A, B, and C), participated in the activity after providing their informed consent, comprising 37 students from Batch A, 44 from Batch B, and 29 from Batch C. Each day, students were divided into two groups for the conduction of closed and open fishbowl activity.

• Closed fishbowl

In the closed fishbowl method, out of the total students, 6-8 students formed the inner circle and the rest formed the outer circle. The time allotted for this activity was 35 minutes. The inner circle was given a topic for discussion based on the lecture with the representative members of their group. The outer circle observed the inner circle and acted as the fish watchers. They took notes on their fish's contribution to the discussion. A fish trainer was appointed to interact only if the conversation got off track. After all the students had been involved in the fishbowl or the 35-minute time limit had passed, the discussion was wrapped up.

• Open fishbowl

In the inner circle, one seat remained empty for students in the outer circle to join the discussion at a certain point. When a student joined, another student left the inner circle to create a new empty seat. The rest of the procedure was the same as the closed fishbowl method. Following the fishbowl interactive sessions, students were administered a post-fishbowl questionnaire via Google Forms.

Outcomes

The outcome variables measured in this study included both quantitative and qualitative indicators of learning effectiveness and student perception. The key quantitative outcomes were the extent of knowledge acquisition, assessed by means of pre- and post-activity MCQs. Qualitative outcomes were gathered from a structured feedback survey consisting of 12 Likert-scale questions and 3 open-ended questions designed to probe into the engagement, clarity, relevance, and overall effectiveness of the fishbowl method.

Data sources/ measurement

Data were collected through structured questionnaires administered through Google Forms. Knowledge acquisition was measured

through 16 meticulously structured recall-level and analytical MCQs on enteric fever, crafted by the researchers and validated by expert judges for content and clarity. The internal consistency of the MCQ instrument was assessed using Cronbach's alpha and demonstrated acceptable reliability (Cronbach's $\alpha = 0.67$). Student perceptions were evaluated using a structured feedback questionnaire that underwent face and content validation by subject experts. The questionnaire demonstrated excellent internal consistency, with a Cronbach's alpha of 0.96. All tools were administered in English, which is the medium of instruction for the students.

Bias

The selection bias was minimized by enrolling all the students from the cohort who gave their consent. Response bias was averted through anonymous feedback. Testing bias would have existed had tests of different kinds been used simultaneously. Using the same validated set of MCQs for both tests prevented that from happening and ensured uniformity in the measurement of the learning outcomes.

Assignment Method

The unit of assignment in this study was the individual student. All participants underwent the same sequence of learning methods – didactic lecture followed by the fishbowl method – without random allocation. Blinding was not applicable as no separate control group was used. To minimize bias due to non-randomization, all students received the intervention under similar conditions, and the same assessment tools were uniformly administered across all participants. Batches were assigned to sessions based on their existing practical class schedule to ensure logistical consistency rather than experimental grouping.

Statistical methods

Data entry and analysis were performed using the trial version of the Statistical Package for Social Sciences (SPSS) software, version 20.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize demographic data and test scores. To assess the effectiveness of the intervention, paired sample t-tests were conducted to compare pre-test and post-test scores. Effect sizes were calculated using Cohen's d to determine the magnitude of the intervention's impact. A p -value of ≤ 0.05 was considered statistically significant.

RESULTS

Among the 110 participants, 52 were boys (47.27%) and 58 were girls (52.73%), indicating a slight female predominance. Across all three batches, female students were in the majority (Table 1).

A statistically significant improvement in student performance was observed following the fishbowl

Table 1. Socio-demographic distribution of participants in each batch

Groups	Participants N (%)		Total
	Male	Female	
Batch-A	17 (45.95)	20 (54.05)	37
Batch-B	21 (47.73)	23 (52.27)	44
Batch-C	14 (48.28)	15 (51.72)	29
Total	52 (47.2)	58 (52.7)	110

method across all batches ($p < 0.001$). The overall mean pre-intervention score was 6.50 ± 2.10 , which increased to 9.07 ± 2.49 post-intervention, yielding a large effect size (Cohen's $d = 1.12$), indicating a substantial magnitude of intervention impact. All groups demonstrated significant gains in knowledge following the fishbowl intervention compared to the traditional lecture alone (Table 2). No statistically significant difference was observed between the closed and open fishbowl formats in either pre- or post-test scores (Table 3).

DISCUSSION

Student perceptions of the fishbowl method were overwhelmingly positive. As detailed in Table 4, a majority of participants (36%) strongly agreed that the method enhanced their understanding, interest, and retention of concepts. Responses to open-ended feedback indicated that students felt a stronger sense of clinical responsibility, improved critical thinking, and highly valued the peer-to-peer interaction. Suggestions for improvement primarily centered on extending the session duration and increasing the frequency of such activities.

The results demonstrated a statistically significant improvement in mean scores post-fishbowl activity (8.62) compared to post-lecture scores (6.03), with a P value of < 0.001 . Furthermore, student feedback also reflected a strong preference for the fishbowl method over the traditional didactic lectures, with over 89% of students agreeing or strongly agreeing that the method was interesting and enhanced their understanding of the topic.

The results suggest that the fishbowl approach successfully allows students to actively engage in learning and to enhance conceptual clarity. This active engagement is theoretically associated with deeper cognitive processing, which in turn drives the better objective learning outcomes in our study. The approach provided students a platform to ask questions boldly and reinforce learning through discussion. Notably, the absence of statistically significant variation between the open and closed fishbowl models shows that both methods are equally helpful in yielding learning outcomes. However, the findings should be interpreted, given the study's emphasis on a single topic and particular

Table 2. Mean differences between post lecture and post-fishbowl questionnaire scores

	Batch A (n = 37) Mean scores (SD)	Batch B (n = 44) Mean scores (SD)	Batch C (n = 29) Mean scores (SD)	Total (n = 110) Mean scores (SD)
Pre-Score	6.84 (2.03)	6.52 (2.18)	6.03 (2.06)	6.50 (2.10)
Post-Score	9.73 (2.06)	8.82 (2.91)	8.62 (2.17)	9.07 (2.49)
p value	< 0.001	< 0.001	< 0.001	< 0.001

Table 3. Mean difference between Closed and Open fishbowl method

Exam Score	Fishbowl Closed (n = 54) Mean (SD)	Fishbowl Open (n = 54) Mean (SD)	p value
Pre-Score	6.35 (2.18)	6.64 (2.04)	p > 0.05
Post-Score	9.07 (2.53)	9.07 (2.47)	p > 0.05

significant objective knowledge enhancement and conceptual understanding following the fishbowl activity. These findings are consistent with those of Hegde et al. (7) and Rabbani et al. (8), who also reported highly significant objective score improvements ($p < 0.001$) using this method. Similarly, Mutalik et al. (9) noted statistically significant improvement in pre- and post-test values when employing the fishbowl strategy, which is

Table 4. Feedback Response Distribution Among Participants

S.N.	Feedback Questions	Likert Scales				
		Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
1	Is method found interesting?	30.91	53.64	8.18	3.64	3.64
2	Understand the topic better& helped in remembering facts easily	36.36	46.36	12.73	1.82	2.73
3	Inspired to read more and enhance self-education	35.45	47.27	10.91	3.64	2.73
4	Inspires critical thinking and analytical skills	31.82	50.91	10.91	3.64	2.73
5	Increased the interest regarding subject	35.45	44.55	14.55	2.73	2.73
6	Helped in correlating principles of disease diagnosis and management	34.55	43.64	15.45	2.73	3.64
7	Clinical learning becomes easier and more enjoyable	38.18	43.64	12.73	2.73	2.73
8	Increased sensitivity towards patient's problem	30.00	52.73	10.00	4.55	2.73
9	This helped me to grasp the concept better	36.36	49.09	10.00	2.73	1.82
10	Communicating skills improved	37.27	41.82	14.55	4.55	1.82
11	Student –teacher interaction is more	39.09	42.73	10.00	6.36	1.82
12	There is an increased sense of responsibility in dealing with actual clinical cases compared to the lecture method	41.82	40.91	12.73	1.82	2.73

cohort.
In the present study, students demonstrated

further supported by Shivalingiah et al. (1).
In our study, students strongly agreed that the

fishbowl method is interesting and preferable to the traditional methods. This finding is consistent with those of Rabbani et al. and Kundoor et al., who have also observed that students preferred small group, interactive teaching (6, 8). Furthermore, Pavani et al. and Beatty et al. demonstrated that lectures followed by fishbowl discussions tend to generate greater student interest, with Pavani reporting almost universal student engagement with the technique (3, 10).

The fishbowl technique also found to be effective in developing better communication skills and topic interest among peers. Our findings regarding enhanced peer communication aligns with those of Jaiswal et al. (5), who reported similar student agreement. Finally, regarding the method's ability to facilitate a better understanding of complex topics, our results were highly consistent with Bhutani et al.'s results, reaffirming the agreement that interactive methods are superior to traditional didactic approaches in promoting deep conceptual clarity (11).

This study has several methodological limitations. First, the single-group pre-post quasi-experimental design lacked a control group, which limits its ability to establish definitive causal inferences. Second, testing and recall bias were potential factors, as the identical 16 MCQs were utilized for both the pre- and post-tests. Third, the study assessed only short-term knowledge acquisition immediately following the sessions, leaving long-term retention and actual clinical application unassessed. Finally, the cohort was limited to a single topic within one institution, which may affect generalizability.

Future research should aim to replicate the study

across multiple topics, disciplines, and institutions to validate and expand the findings.

CONCLUSION

The findings of this study provide compelling evidence for the importance of student-centered learning approaches and highlight the need for educators to continually innovate and refine their teaching practices to optimize student learning outcomes. Ultimately, the integration of the fishbowl method into microbiology education has the potential to transform the way students learn and interact with complex concepts, leading to better academic performance and a more profound understanding of the subject matter.

Ethical Considerations:

Ethical issues including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc. have been completely observed by the authors. The study protocol received approval from the Institutional Ethics Committee Shri Balaji Institute of Medical Sciences, Raipur, Chhattisgarh, India, prior to initiation vide letter no. SBIMS/IEC/Certi/01, dated 11th Nov., 2024. Written informed consent was obtained from all the students. Participant confidentiality and privacy were strictly maintained throughout the study duration.

ACKNOWLEDGMENTS

Financial Support: Not applicable

Conflict of Interest: The authors declare that they have no competing interests.

REFERENCES

- Shivalingiah J, Ramanathan R, Raajaseharan SR, Jeyabanu S, Rekha S, Rammohan N. Role of various small group teaching methods in enhancing learning among medical undergraduate students - a comparative study. *Natl J Physiol Pharm Pharmacol*. 2019; 9(12):1163-6.
- Kenchaiah S, Krishna P. Comparative study of case based learning with traditional teaching method in pharmacology for second year MBBS students. *Int J Basic Clin Pharmacol* 2016; 5:1210-4.
- Pavani G. Fish bowl teaching technique for II year MBBS students in AIMS. *J Evolution Med Dent Sci*. 2016;5(32):1713-5.
- Garg R, Singh VA. Introduction of case based learning in microbiology at undergraduate level. *Natl J Lab Med*. 2018;7(3): MO06-MO10.
- Jaiswal R. Small group discussion versus traditional lecture in anatomy teaching: a cross-sectional study. *Int J Anat Radiol Surg*. 2023;12(3): AO09-AO14.
- Kundoor N, Sannidhi S, Bashetty S. Effectiveness of fish bowl method in teaching clinical bio-chemistry for 1st year medical students. *Int J Med Sci Educ*. 2019; 6(1):1-5.
- Hegde AM, Shetty S, Mehrotra D. Comparison of classroom lectures with fishbowl snowball activity for dental undergraduate students: an observational study. *J Health Allied Sci*. 2023;13:395-9.
- Rabbani H, Tarannum F, Chavan VM, Ali SI. Fish-bowl teaching technique in phase III MBBS students: an observational study. *J Clin Diagn Res*. 2023; 396-401.
- Mutalik MM. Student perceptions and learning outcome on a 'fishbowl' strategy-based pharmacology seminar on drug dependence. *Int J Basic Clin Pharmacol*. 2016; 5(3):879-83.
- Beatty ID. Transforming student learning with classroom communication systems. *Educause Cent Appl Res Bull*. 2004; 2004(3):2-13.
- Bhutani N, Arora D, Bhutani N. A Comparison of Effectiveness of Interactive Methods over Traditional Methods in Teaching Biochemistry to Undergraduate Medical Students. *Int J Recent Innov Med Clin Res* 2020; 2(2):57-63.