A Crossover Design on Effectiveness & Comparison of 3 Different Innovative Teaching Method in Case Based Learning for First Year MBBS on Biochemistry at CIMS, Chikkamagaluru

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Abstract:

Objective: Fishbowlw Case Based Learning (CBL), forms a bridging gap between theory & and practice, to achieve reasoning skills and competence we introduced 3 different teaching techniques Fish Bowl (FB), Jigsaw (JS), and Flipped Classroom (FCR) among MBBS students.

Methodology: A crossover design study was done among first-year MBBS students for a period of 6 weeks at CIMS, Chikkamagaluru. A total of 150 students were divided into 3 groups (50 in each group) and underwent 3 rounds so that each group was exposed to all 3 techniques. Assessment was done by conducting pretest and post-test MCQs. Feedback was taken from both students and facilitators.

Results: The difference in the means of analysis between two-time points in the same group was tested by paired t-test. Significant improvement in performance pre v/s posttest. Difference of means analyzed by ANOVA & F testing. 1st & 2nd round showed FCR had higher mean (7 ± 1.7, 7.8 ± 1.2) compared to JS (6.3 ± 2.1, 7.4 ± 1.6) and FB (6.6 ± 2, 7.5 ± 1.7) whereas 3rd round showed FB & FCR were had higher mean (6.2 ± 1.9, 6.2 ± 1.7) which was statistically significant at ($p<0.001$) compared to jigsaw (6.1 ± 2).

Conclusion: Our study showed there is a positive reinforcement & and improvement in the student's performance among FCR & FB teaching techniques compared to the JS method.

Keywords: Cased Based Learning, Fishbowl, Jigsaw, Flipped Classroom, Clinical Biochemistry.

Introduction

Clinical biochemistry is a foundational subject that gives a biochemical basis and diagnostic approach to most diseases [1,2]. Hence Case-based learning closes the loopholes between theory and practice by providing veritable case scenarios to the students under the aegis of inquisitive-based learning which is composed of 5 E elements i.e., Engage, Explore, Explain, Elaborate, and Evaluate [3].

Under Bloom's revised taxonomy, teacher-centered learning makes students engross only a one-horse cart [4]. On the other hand, there is a gap between knowledge concerning & and knowledge retention in teaching Biochemistry.

A famous educationalist John Holt said "Learning is not the product of teaching. Learning is the product of the activity of learners" [5], thus we introduced 3 different innovative teaching techniques for Case-based learning such as Fishbowl (FB),

Jigsaw (JS), and Flipped Classroom (FCR) where all 3 were student's-centered approaches.

The fishbowl (FB) method ameliorates the communication skills of students for a labyrinthine discussion and involves the active participation of students creating a more efficient, productive, and engaging classroom environment [6,7,8]. Whereas Jigsaw (JS) is cooperative learning in which students work in small groups, each student feels validated [9], and primarily used for the acquisition [10] and presentation of new material [11]. In the case of the flipped classroom (FCR), it is a blended learning where students learn foundational material from outside of the classroom via online, annotated PPTs or any other resources thereby enhancing critical thinking and reasoning skills to achieve competence [12].

Methodology

A crossover study design was conducted in the Department of Biochemistry at the Chikkamagluru Institute of Medical Sciences, Chikkamagluru, Karnataka for a period of 6 weeks. The study commenced after getting ethical clearance from the Institution and informed consent from students. Conducted 3 rounds so that all students were exposed to all 3 techniques i.e. Fishbowl Method, Jigsaw Method & Flipped Classroom (FCR). A total of 150 students were divided into 3 groups. Each group consisted of 50 students each.

First Roundb Nearly 138 students were present on that day. Cases were Alcoholic liver disease, Mul-

tiple Myeloma, Acute inflammation due to rheumatoid arthritis, and Nephrotic Syndrome.

Second Round: Nearly 135 students were present. Cases were Beta-thalassemia major, Beta-thalassemia minor, Sickle Cell Anemia, and Homozygous Sickle Cell Anemia.

Third Round: Nearly 135 students were present. Cases were Carbon monoxide poisoning, Acquired methemoglobinemia, and congenital methemoglobinemia.

For each technique, facilitators were assigned to this study.

Table 1:

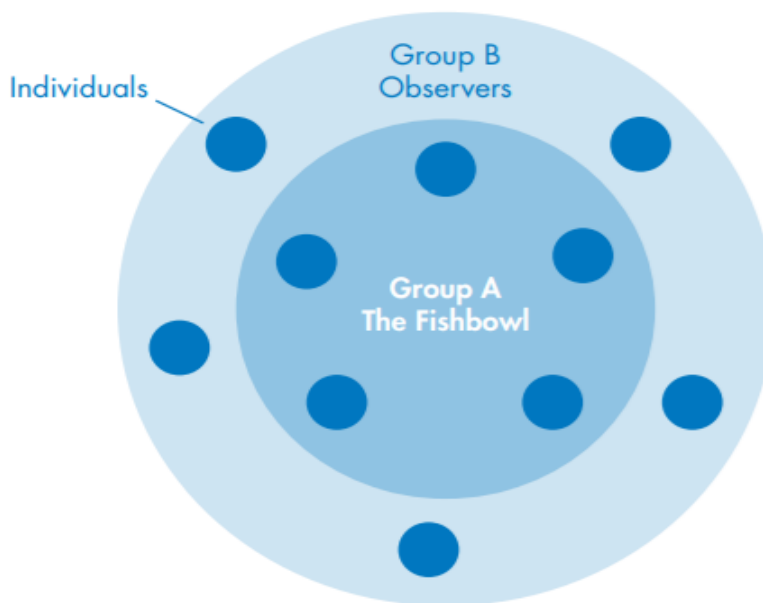| Group	First Round	Second Round	Third Round
I Group (1-50)	Jigsaw	Fish Bowl	Flipped Classroom
II Group (51-100)	Flipped Classroom	Jigsaw	Fish Bowl
III Group (101-150)	Fish Bowl	Flipped Classroom	Jigsaw

Fish Bowl Methodology

Figure 1: The Fishbowl

Step 1: Cases were posted one day before class, to achieve more reasoning skills and to become effective.

Step 2: Arrangement of the classroom by creating a "circle of chairs" and forming inner and outer circles by students.

Step 3: Explain the protocol. The inner circle of students is the one who will initiate the discussion among themselves for a given case. The time allotted for each case was 10 minutes. The outer circle

of students should be focused, observed, and should make notes regarding the discussion. Not allowed to speak. After ten minutes the facilitator will say "Switch". At that time outer circle of students will sit on chairs and become the inner circle and they will become speakers.

Step 4: At the end, a facilitator will wrap up the discussion.
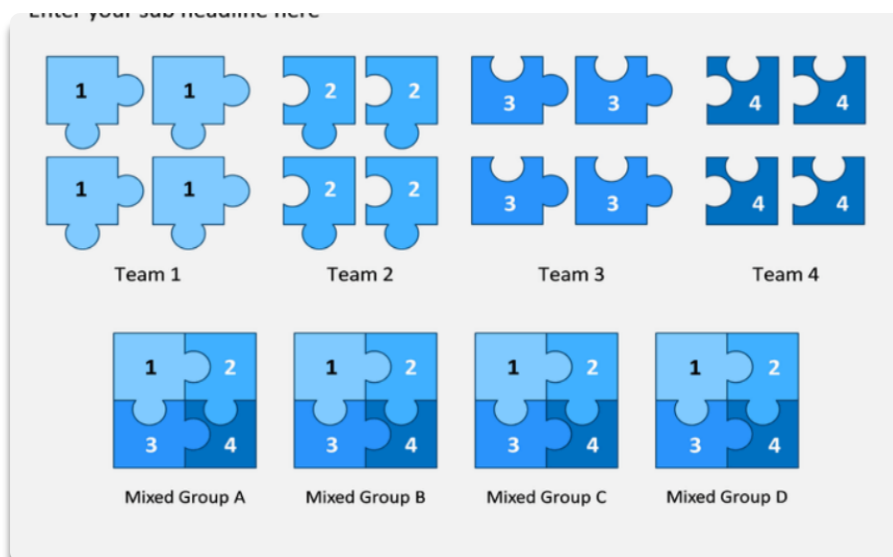
Jigsaw Methodology

Figure 2:

Step 1: Creating a "home group". 48 students were divided into subgroups of 12 and each subgroup had 4 students.

Step 2: Cases were allotted to each student present in the subgroup.

Step 3: Creating an "Expert group". That is selecting one student from each subgroup who has similar cases. Created 4 expert groups.

Step 4: For all expert groups, the time was allotted for 15-20 minutes for discussion.

Step 5: The expert group will return to their respective "home groups" and they will present the case.

Step 6: At the end, the facilitator will wind up the discussion of each case
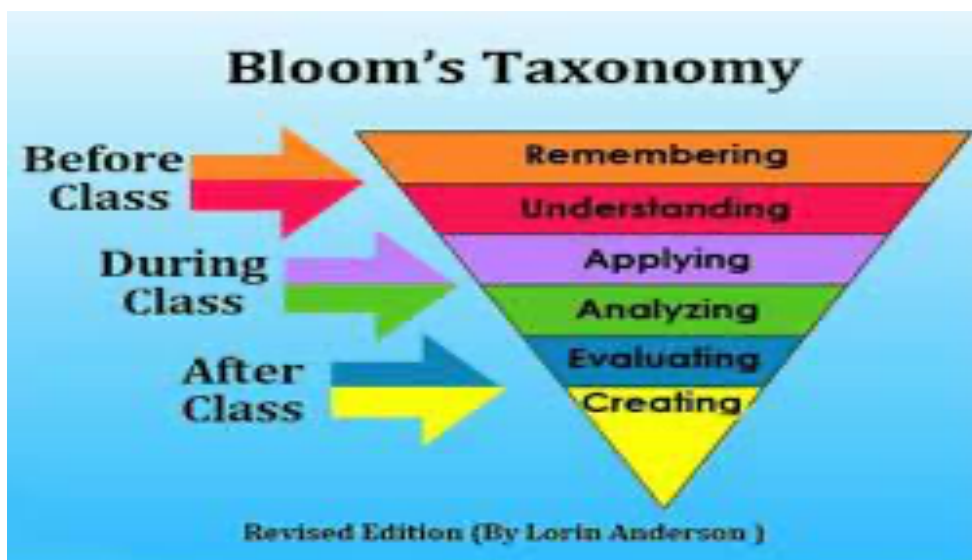
Flipped Classroom Methodology

Figure 3: Bloom's Taxonomy

Step 1: Pre-reading resources were given one day before class.

Step 2: In the classroom, students were allowed to read themselves either individually or groups. The allotted time was 45 minutes.

Step 3: At the end, the facilitator will discuss the cases.

Assessment was done for all three 3 rounds by conducting pre-test and post-test which were based on MCQs. Feedback was taken from both students and facilitators.

Results were analyzed by using MS Excel and SPSS software versions. Evaluation of the teaching tool was done by using the Kirkpatrick model (levels 1 and 2 were assessed).

Level 1: student's perception towards FCR, FB & JG was assessed by feedback's questionaries.

Level 2: Student's learning is assessed by Pre test & Post test by MCQ's

Results: All characteristics were summarized descriptively. For continuous variables, the summary statistics of mean ± standard deviation (SD) were used. The difference in the means of analysis variables between two-time points in the same group was tested by paired t-test. The difference in the means of answers in variables between more than two independent groups was tested by ANOVA and F test of testing of equality of Variance. If the p-value was < 0.05, then the results were statistically significant. Data were analysed evusing SPSS software v.23 (IBM Statistics, Chicago, USA) and Microsoft Office 2007.

Table 1: Round one showing pre-test & post-test (Mean ± SD) & (Mean Difference) of all 3 techniques

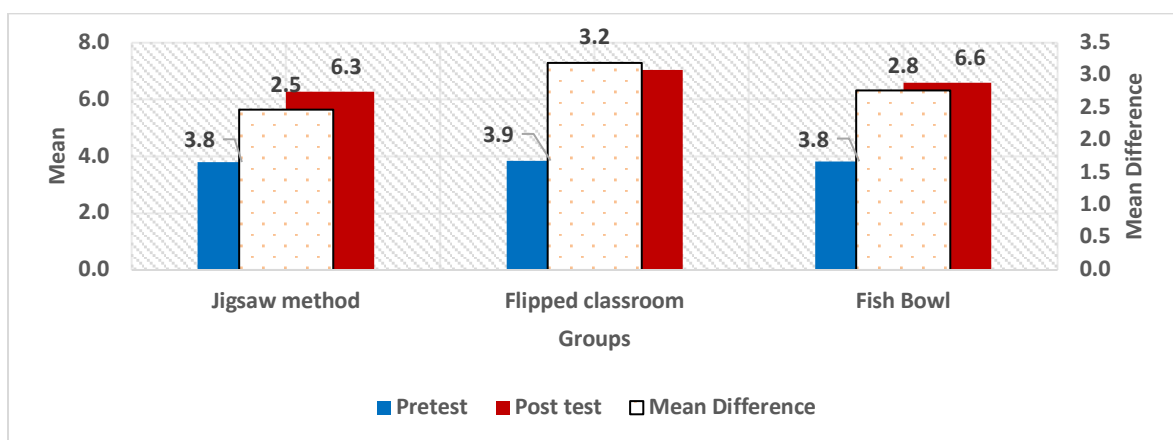| Groups	Pretest		Post-test		Mean Difference	p-value	95% CI	
	Mean	SD	Mean	SD			Lower	Upper
Jigsaw method	3.8	2.0	6.3	2.1	2.5	<0.001*	-3.1	-1.9
Flipped classroom	3.9	1.6	7.0	1.7	3.2	<0.001*	-3.8	-2.6
Fish Bowl	3.8	1.9	6.6	2.0	2.8	<0.001*	-3.4	-2.1

Figure 4: Shows a graphical representation of the pre-test and post-test (Mean and mean difference) of round 1 on all three methods

Table 2: Round two shows the pre-test and post-test (Mean±SD) and (Mean Difference) of all 3 techniques

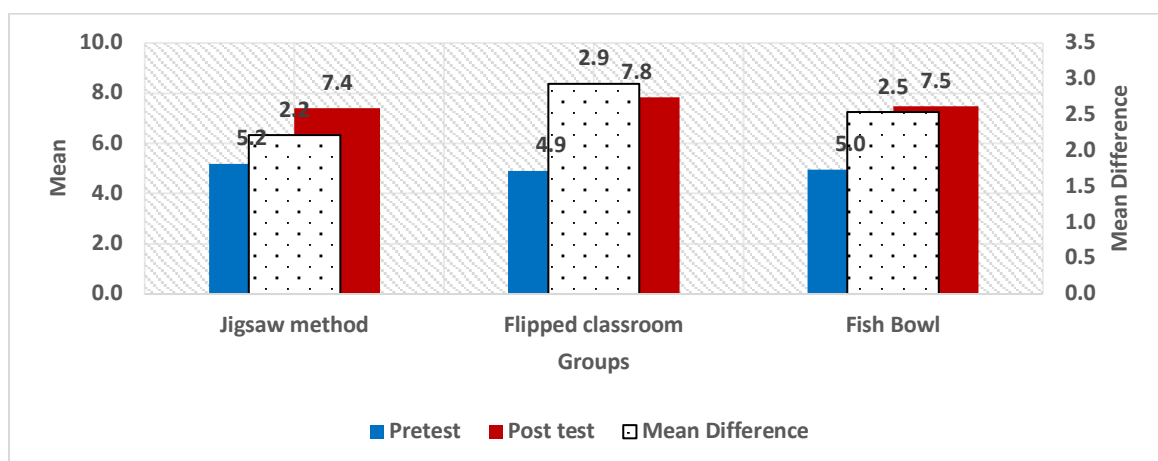| Groups	Pretest		Post-test		Mean Difference	p-value	95% CI	
	Mean	SD	Mean	SD			Lower	Upper
Jigsaw method	5.2	1.6	7.4	1.6	2.2	<0.001*	-2.8	-1.7
Flipped classroom	4.9	1.6	7.8	1.2	2.9	<0.001*	-3.4	-2.5
Fish Bowl	5.0	1.9	7.5	1.7	2.5	<0.001*	-3.2	-1.9

Figure 5: Shows a graphical representation of the pre-test and post-test (Mean and mean difference) of round 2 on all three methods

Table 3: Round three shows the pre-test and post-test (Mean±SD) and (Mean Difference) of all 3 techniques

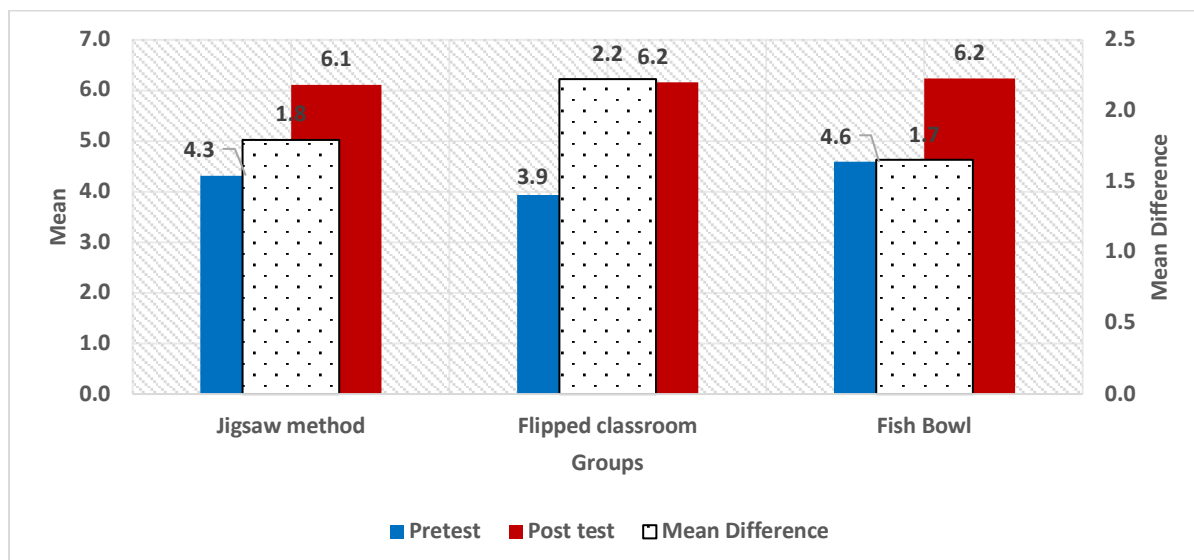| Groups	Pretest		Post test		Mean Difference	p value	95% CI	
	Mean	SD	Mean	SD			Lower	Upper
Jigsaw method	4.3	1.8	6.1	2.0	1.8	<0.001*	-2.5	-1.1
Flipped classroom	3.9	1.7	6.2	1.9	2.2	<0.001*	-2.9	-1.6
Fish Bowl	4.6	1.9	6.2	1.6	1.7	<0.001*	-2.4	-0.9

Figure 6: Shows a graphical representation of the pre-test & and post-test (Mean and mean difference) of round 3 on all three methods

Table 4: Shows feedback questionnaire which is based on the likert scale

| |
|---|
| 1. Pre reading materials were available before class? |
| 2. Adequate time was given before class? |
| 3. Pre reading and ppt were revalent for classroom discussion? |
| 4. Classroom arrangement was conducive? |
| 5. Activites during class session improved my understanding of the key concepts. |
| 6. Activites inspired to perceive further learning? |
| 7. More lectures should be conducted by today's method? |
| 8. Instructor was able to engage me in the activity? |
| 9. Instructor was able to provide clarification on difficult concepts during activity? |
| 10. Whether instructor was able to expand on pre –reading materials during classroom? |
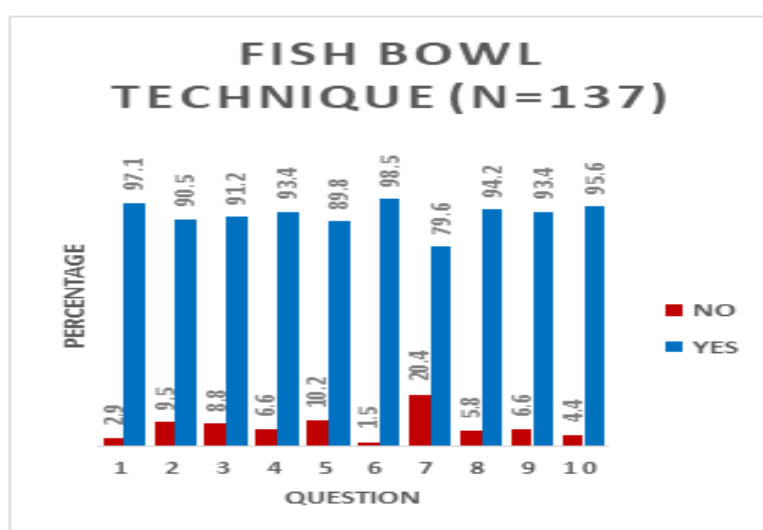
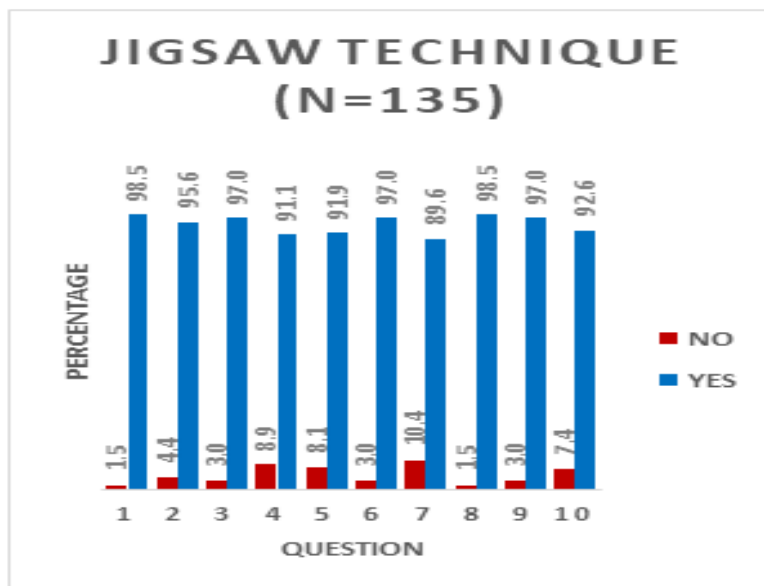**Figure 7: FISH BOWL Technique (N=137)**
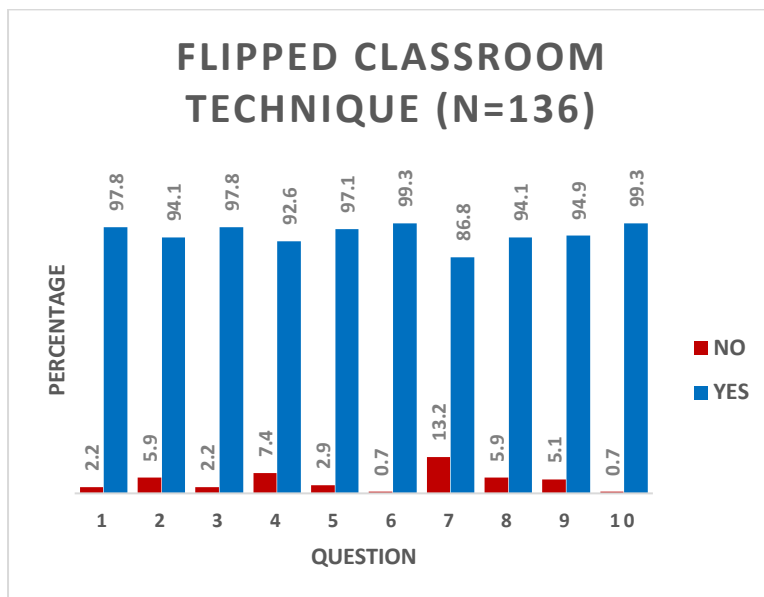
Figure 8: JIGSAW Technique (N=135)

Figure 9: Flipped classroom technique (N=136)

Table 5: Feedback questionnaire from Facilitators which rated from 1 to 5

| Feedback Form |
|---|
| Was this FB/JS/FCR relevant clinically to discuss the cases? |
| Did this FB/JS/FCR provide a non-threatening low stake learning group environment to the students? |
| Was this FB/JS/FCR suitable to implement integration of learning with higher phases subject? |
| Was this FB/JS/FCR suitable to give pedagogical material that encourages problem solving? |
| Was this type of FB/JS/FCR help students to ask to questions & interact? |
| Is this FB/JS/FCR technique feasible to conduct? |
| Was this FB/JS/FCR technique suitable for the topic discussed? |
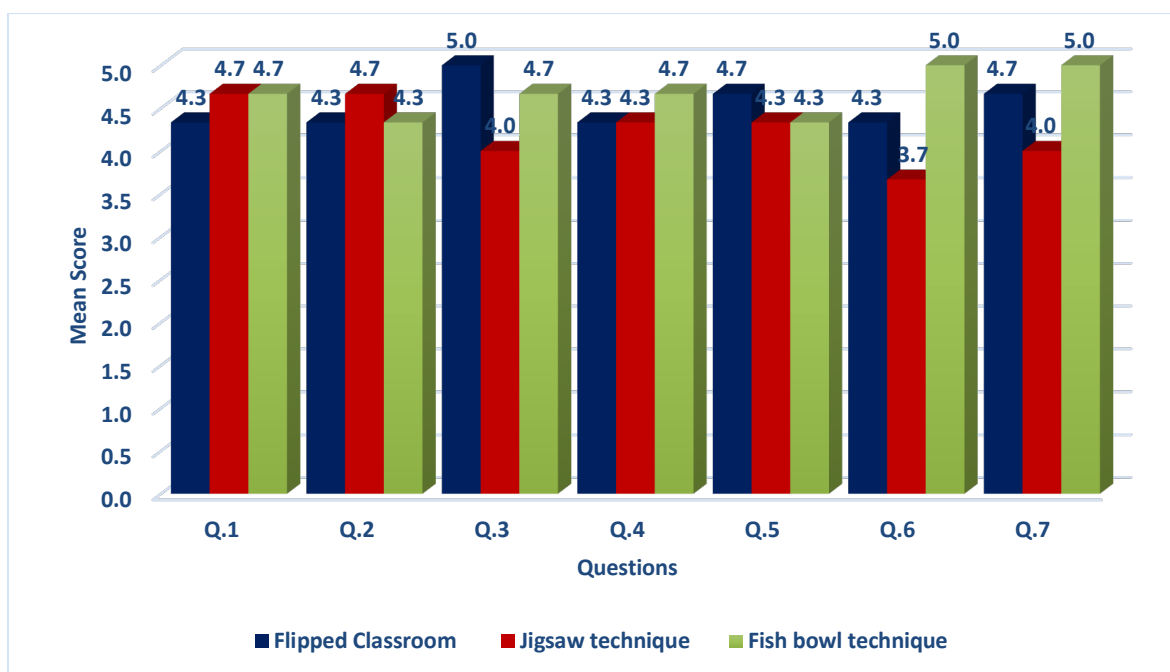
Figure 8: Shows a graphical representation of the average rating for each question from Facilitators

Discussion

Generally, in Case based learning, the instructor/teacher will present the case & doesn't interact intensively with students, again where it's becoming teacher-centered learning i.e. passive teaching method. As we are aware of knowledge retention rates of the learning pyramid which have shown that by doing "lecturing", the knowledge retention rate is 5%, but if there is an activity among students such as "discussion" among groups or "teaching others" have shown that knowledge retention rate has tremendously increased to 50% and 90% respectively. That is the main motto of this study.

Thus, in our study we made an activity among students by applying fishbowl, jigsaw and flipped classroom method for case scenarios and conducted thrice with different case scenario topics, so that each student should be exposed to each technique.

There is a colossal improvement in all three techniques where we conducted pre-test & post-test for an analysis (Table No.1, 2 & 3 shows Mean ± SD). Among all three techniques, Flipped Classroom showed higher Mean ± SD successively in 1st, 2nd & 3rd rounds which was highly statistically significant $p<0.001$) compared to Fishbowl and Jigsaw. In third round, along with FCR, the Fishbowl method showed higher mean values.

On other hand, a study conducted by Hanadi et al., showed positive perception towards FCR which was a case control study & compared to traditional lecture method [13]. FCR, was a proven technique in a systematic review which consisted of 82 papers showed student's impetus & diligent [14]. Another study conducted via meta-analysis of forty-six pa-

pers included 9,000 participants showed higher academic execution [15]. Fishbowl, an interactive activity which improves listening & immersed among students [7]. Amitha et al., study combined with snowball along with FB technique showed increased comprehension & retention of concepts [16].

Even the feedback's from the students for all 3 teaching techniques showed positive encouragement & have emanated interest in biochemistry & not only that they also want to cover more topics by any one of above activities. Feedback's from all facilitators feels the same & showed positive response to all 3 activities. Thus, by introducing any above method would lead to small group discussions where students will become more alert, focused & provides an opportunity for one-to-one interaction within group. Thereby peer pressure indirectly beneficial to the students.

Conclusion

By applying interactive session for case-based learning especially flipped classroom & fishbowl method showed positive fortify & better performance among first year medical students.

Limitations

1. It was non-randomized study.
2. Evaluation assessed by Kirkpatrick model; level 3 (measures behavior changes after learning) & level 4 (focuses on whether the targeted outcomes resulted or not from training program) couldn't assess.
3. Since topics were varied, it may lead to biased.

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