Students` Perception of Their Engagement and Problem-Solving Skills Using Team-Based Learning at Fazaia Ruth Pfau Medical College, Karachi

ShahJabeen Khan[1], Muhammad Faisal Rahim[2], Shireen Qassim Bham[3], Masood Ahmed Shaikh[4], Sama ul Haque[4], Tahir Ansari[5]

[1]Physiology Department, [2] Medical Education Department, [3] Pediatrics Department, [4] Anatomy Department, [5] Medicine Department, Fazaia Ruth Pfau Medical College, Air University, Karachi

ABSTRACT

Background: Team-based learning is a relatively new or most recent teaching strategy that has been adopted in medical schools. This study evaluated students' perception of critical thinking, and problem-solving skills using Team-Based Learning (TBL) as a strategic tool.

Methods: A descriptive, cross-sectional study using convenient sampling among 300 first, second, and third-year MBBS students was conducted. A total of 6 TBLs were held for each MBBS class and 18 TBLs were held in all three years from February to October 2023 at Fazaia Ruth Pfau Medical College (FRPMC), Karachi. A 5-point Likert scale questionnaire was used to evaluate the students' perception and problem-solving abilities. Data was collected and analyzed using SPSS ver.25. A pilot study was done on 55 participants and Cronbach's alpha was used to determine the reliability of the questionnaire.

Results: A total of 269 out of 300(89.6%) students responded that the pre-reading material given was appropriate for the TBL session. Similarly, 268(89%) students agreed that the TBL's learning objectives were in line with the lectures. Students' engagement 237(79%) was higher when compared with problem-solving skills 216(72%) as attained through TBL. Students' overall opinions were rated above 75% for the category of agree and strongly agree on the rating scale with a mean score of 3.96 out of 5 for all claims. The Cronbach Alpha for the pilot study was 0.909.

Conclusion: There was an overall positive perception of medical students for all attributes of TBL indicating that student engagement was more successfully identified than problem-solving abilities.

Keywords: Educational Techniques, Learning, Problem-Based Learning.

Corresponding Author:
Dr. Muhammad Faisal Rahim
Medical Education Department,
Fazaia Ruth Pfau Medical College,
Air University,
Karachi, Pakistan.
Email: mfaisalrahim@gmail.com

Doi: 10.36283/PJMD13-3/024

How to cite: Khan SJ,Rahim MF,Bham SQ,Shaikh MA, Haque SUL,Ansari T Students` Perception of Their Engagement and Problem-Solving Skills Using Team-Based Learning at Fazaia Ruth Pfau Medical College, Karachi. Pak J Med Dent. 2024;13(3): 172-178. Doi: 10.36283/PJMD13-3/024

Received: Fri, Feb 23, 2024 **Accepted:**Thu, June 13, 2024 **Published:** Wed, 24 July 2024

INTRODUCTION

Medical academia specialists have been required to look for strategies to switch from a passive learning process to an interactive learning strategy due to the rapid growth of knowledge and ongoing advancements in medical curricula. With an active deep learning approach in a small group teaching environment, team-based learning (TBL) is a relatively newer teaching strategy introduced in many medical schools[1].

TBL has given students the chance to apply their conceptual knowledge in a team with an immediate feedback mechanism[2]. Through a series of activities created to improve conceptual knowledge, and analyze, and apply information to solve challenging issues and complicated problems through team discussion, TBL infrastructure actively involves students in the learning process. The facilitator`s pre-TBL tasks give students the chance to engage in self-directed learning activities and demonstrate their commitment to teamwork during TBL sessions. Additionally, TBL's organized readiness assurance procedure and built-in quick feedback system offer a more uniform evaluation of students' engagement and readiness[3].

Students not only acquire knowledge and understanding of the applied concepts during pre-TBL sessions but express their knowledge and understanding during TBL discussion sessions to advance the discussion, producing a sense of accomplishment that further increases student engagement for TBL[4]. Through debate and in-class problem-solving exercises, TBL involves students in an active learning process, unlike typical didactic lectures or tutor-centered tutorials[5]. Additionally, it motivates them to collaborate with others to complete all of their TBL assessment-related duties[6].

Producing qualified doctors capable of providing high-quality medical treatment that improves patient outcomes is the ultimate goal of medical education[7]. According to studies, a patient-centered healthcare strategy depends largely on team-based skills. Through the gradual accumulation of knowledge, TBL improves students' deep learning processes[2, 8]. This allows them to integrate the learned material, correlate the theories and mechanisms that underlie complex clinical situations, and, ultimately, improve their problem-solving abilities, which are crucial for providing high-quality care in actual clinical settings[9]. The required engagement of the students makes them able to achieve their short-term and long-term learning outcomes and helps them to perform better in their clinical practices[10].

The curriculum of Fazaia Ruth Pfau Medical College was delivered using a range of teaching and learning strategies. Since traditional methods of instruction constituted most of the curriculum, it was difficult to determine how much the students had learned from those strategies and none of them improved their level of engagement or problem-solving skills. TBL was initially introduced to enhance students` critical thinking skills and improve their involvement in class discussions. TBL was incorporated as an add-on to teaching and learning methodologies during the first three years of the MBBS program in 2022. This study was therefore designed to evaluate students` problem-solving activities, their critical thinking, and their participation in discussions that they had developed through TBL.

METHODS

A descriptive, cross-sectional research design was used. The participants were MBBS students in their first, second, and third years. At Fazaia Ruth Pfau Medical College, team-based learning sessions were conducted throughout the 2022 academic year.

TBL was regarded as one of the teaching and learning approaches in the medical curriculum's integrated modular structure. Each year of the MBBS program, six TBLs were held for each class, for a total of 18 TBLs held over the three years. TBL takes roughly 2 hours and 15 minutes to complete. This process consists of the distribution of TBL objectives and pre-reading material before the commencement of TBL, reading material was given in the form of PowerPoint slides, PDFs, and video links, at least 4-5 days before the date when TBL was held. To check prior knowledge and what students learn before coming to the TBL, the Individual Response Assessment Test (iRAT) was conducted at the start of the TBL session, this was followed by the Team Response Assessment Test (tRAT), where discussions take place among group members and then each group submits their tRAT answers after consensus build during discussion. At least 4-5 days before the date on which TBL was held, reading material was provided in the form of PowerPoint slides, PDFs, and video links. This process involves the delivery of TBL objectives and pre-reading materials to the students. Individual Response Assessment Tests (iRAT) and Team Response Assessment Tests (tRAT), which involve group discussions and the submission of tRAT answers after consensus has been reached during the discussion, were administered at the beginning of the TBL session to assess prior knowledge and what the students had learned before coming to the TBL. Each question from the tRAT was discussed among the students for clarification before the submission of the response sheets from each group in this activity, in addition to this any misconceptions were also cleared up by the facilitators during the discussion. The case was once again distributed for group discussion. Application exercises were either conducted in the class in the form of Multiple-choice questions related to the case provided earlier or sometimes application exercise was uploaded on Learning Management System (LMS) Moodle and students were expected to complete this exercise within a week.

5-point Likert questionnaires were designed to show agreement between raters. Responses were categorized into 1 = "Strongly disagree", 2 = "Disagree", 3 = "Neither or neither", 4 = "Agree", and 5 = "Strongly agree". The results obtained from a 5-point Likert scale questionnaire were represented in frequency tables with percentages, counts, mean, and standard deviations. The questionnaire consists of questions validated by previous research and also by TBL experts[11]. The questionnaire consists of Nineteen questions which were related to the student's login and registration process followed by the role of the facilitator in conducting the TBL, establishing the ground rules for the session, and most importantly, the student's perspective on their participation in group discussion. It also consisted of questions to what extent students feel that they have acquired critical and problem-solving skills after attending these TBL sessions.

The sample size of this study is 300 which are medical students from 1st, 2nd, and 3rd-year MBBS classes sampling size estimation was done with a convenient sampling technique as this is educational research convenient sampling allows us to take all samples which is available in our case are all students were added from all three class which make our sample size 300 with 100 students from each class. Each student's consent to participate voluntarily in the study was obtained, along with ERB approval. (Ref No: FRPMC-IRB-2023-26).

Statistical Analysis includes developing Frequency Tables in SPSS, while the graph was tabulated using Microsoft Excel. Cronbach's alpha was used to determine the reliability using SPSS version 25 of the instrument (Questionnaire) [12]. Results of responses from students for the strongly agree and agree category on the 5-point Likert scale questionnaire were also combined in a cumulative table showing frequencies in percentage in Table 3, they were also grouped into different color codes according diverse nature of questions on 5-Point Likert Scale. In Table 3 results of different questions were groups for instance, the percentages of responses for agree and strongly agree combined for questions related to role facilitators, similarly students` engagement questions percentages combined, moreover, questions related to students` skills for as critical thinking, problem-solving, and clinical knowledge were also combined and expressed as a pooled percentage with color coding.

RESULTS

All students (n = 300) participated in the study with a 100% response rate. As shown in Table 1, most of the students 269 out of 300 (89.6%) thought that pre-reading material given in the form of PowerPoint presentations, handouts, PDFs, and video links was appropriate for the TBL session. Furthermore, 267 out of 300 (89.0%) of students agreed or strongly agreed that the learning objectives of TBL were aligned with the lectures given before the session. Similarly, 237 out of 300 (79%) students feel that the tutor did a pretty decent job in conducting TBL sessions by setting up the ground rules for the session, facilitating and focusing discussions among students and they were given timely feedback during group discussions. In addition to this, a few questions were also asked about how TBL helps in the initiation of prior knowledge among students through iRAT activity and group discussions, the responses were very positive, and 210 (70%) out of 300 or more thought that not only TBL helps them in bringing contextual knowledge but also helps them to integrate basic subject knowledge with clinical subjects.

Table 1: Results obtained from Students` responses on a 5-point Likert scale questionnaire.

S. No	Questions	Strongly Agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)	Strongly Disagree n (%)	Mean on 5-point Likert Scale
1	The reading material was appropriate.	130(43.3)	139 (46.3)	23 (7.6)	3 (1)	5 (1.7)	4.29
2	Learning objectives were according to topics taught in previous lectures and tutorials.	151(50.3)	117 (39)	22 (7.3)	3 (1)	7 (2.3)	4.34
3	Ground rules were laid before the session	111 (37)	128 (42.7)	48 (16)	5 (1.7)	8 (2.7)	4.1
4	The tutor facilitated on focused discussion and learning	132 (44)	120 (40)	35 (11.6)	5 (1.7)	8 (2.7)	4.21
5	Timely feedback was given from tutors	115(38.3)	122 (41.7)	46 (15.3)	7 (2.3)	10 (3.3)	4.08
6	The tutor makes students able to achieve all objectives and intended learning outcomes during the discussion	132 (44)	116 (38.7)	38 (12.6)	7 (2.3)	7 (2.3)	4.2

7	Discussions on cases help students be problem solvers and critical thinkers.	113(37.7)	120 (40)	34 (11.3)	20 (6.7)	13 (4.3)	4
8	TBL helps in building integrated knowledge among basic sciences with clinical context.	90 (30)	108 (36)	64 (21.3)	31 (10.3)	7 (2.3)	3.81
9	Improves communication skills among students.	106(35.3)	120 (40)	57 (19)	12 (4)	5 (1.7)	4.03
10	Help in improving clinical reasoning skills in the context of Basic science subjects.	115(38.3)	121 (40.3)	46 (15.3)	13 (4.3)	5 (1.7)	4.09
11	TBL questions improve the retention of prior knowledge.	118(39.3)	111 (37)	40 (13.3)	22 (7.3)	9 (3)	4.02
12	Working in a team was a valuable experience.	125(41.7)	105 (35)	53 (17.6)	9 (3)	8 (2.7)	4.1
13	Other team members and you have equally contributed and worked as a team.	116(38.7)	126 (42)	39 (13)	9 (3)	10 (3.3)	4.1
14	Allowed to express an opinion even if it is different from others.	116(38.7)	133 (44.3)	36 (12)	6 (2)	9 (3)	4.14
15	TBL preparation is a less time-consuming activity.	74 (24.7)	98 (32.7)	69 (23)	33 (11)	26 (8.7)	3.54
16	Less preparation is involved for TBL.	59 (19.7)	94 (31.3)	83 (27.6)	45 (15)	19 (6.3)	3.43
17	Learning in a team helped to understand course material more than studying alone	109(36.3)	119 (39.7)	53 (17.6)	10 (3.3)	9 (3)	4.03

As shown in Table 2 when comparing students` engagement with problem-solving skills achieved during TBL, results were measured with grouped and cumulative percentages compared among various groups' categories. The percentage of statements related to students' engagement was rated higher 237 out of 300 (79%) than the problem-solving skills 216 out of 300 (72%) in the cumulative results.

Only one measure out of 17 statements, the statement where students were asked "Do they were provided with sufficient time to prepare for their TBL", resulted on a 5-point Likert scale in Table 1 students' ratings were 172 out 300 (less than 58%). This was the only measure that was rated lowest among all questions on the Likert scale questionnaire.

Table 2: Frequencies and Percentages on 5-point Likert scale questionnaire in cumulative grouped categories.

Questions	Strongly Agree & Agree (Count out of 300)	Percentages (%)	Cumulative % in categories
Reading material and resources were appropriate	269	89.67%	**90%**
Learning objectives were according to topics taught in previous lectures and tutorials.	268	89.33%	
Ground rules were laid before the session	239	79.67%	
The tutor facilitated on focused discussion and learning	252	84.00%	**82%**
Timely feedback was given from tutors	237	79.00%	
The tutor makes students able to achieve all objectives and intended learning outcomes during the discussion	248	82.67%	
Discussions on cases help students be problem solvers and critical thinkers.	233	77.67%	**72%**
Help in improving clinical reasoning skills in the context of Basic science subjects.	198	66.00%	
TBL helps in building integrated knowledge among basic sciences with clinical context.	226	75.33%	

Improves communication skills among students.	236	78.67%	
TBL questions improve the retention of prior knowledge.	229	76.33%	
Working in a team was a valuable experience.	230	76.67%	**79%**
Other team members and you have equally contributed and worked as a team.	242	80.67%	
Allowed to express an opinion even if it is different from others.	249	83.00%	
Learning in a team helped you to understand course material more than studying alone	228	76.00%	
TBL preparation is a less time-consuming activity.	172	57.33%	
Less preparation is involved for TBL.	153	51.00%	
I prefer TBL over other teaching and learning strategies i.e., Lectures, tutorials, practical	143	47.67%	
The time given for the preparation of TBL was sufficient	146	48.67%	**<50%**

**Different colors represent different categories.*

The internal consistency of all items in the questionnaire is calculated with Cronbach Alpha value which came out to be 0.909 which is on the high end and shows that all items in the questionnaire were consistent and reliable as shown in Table 3.

Table: 3. Internal Consistency of Questionnaire with Cronbach`s Alpha Value

Cronbach's Alpha	Mean	Standard Deviation	Variance	No. of Items
0.909	3.962	1.009	1.019	19

DISCUSSION

This study demonstrates our dedication to effectively illustrate a learning-centered culture, with an emphasis on adapting new modalities of medical education (shifting from passive to active learning). Team-based learning not only promotes individual student accountability, engagement, and teamwork but also alters instructors' roles from information providers to learning facilitators for students[12]. Our study provides credence to the notion that TBL benefits students' knowledge acquisition.

With the overwhelming majority of students strongly agreeing with the questions, our students' perspective on involvement and problem-solving abilities was much higher. Pre-reading materials provided and learning objectives matching previously taught material were the two key queries that garnered higher ratings. TBL's beneficial impacts can be attributed to two crucial elements of its design: peer teaching and accountability. Reading material given beforehand gives them ample time to work independently to prepare for team sessions where they will collaborate with their teammates to solve challenges[13]. According to the responses of the students regarding readiness assurance, this approach improved motivation and information acquisition while also fostering a better comprehension of the course material. Our study anticipated that prior knowledge would help them integrate basic science knowledge with clinical skills. A similar response was noted in a study done by Whillier S[14]. Thus, TBL helps students quickly acquire the attitudes and abilities required for group discussion, problem-solving collaboration, and learning from their colleagues[15].

Another key factor in our study which students affirmed is the role of the facilitator in conducting the session, setting the ground rules, and providing focused discussions with timely feedback. Conflict that arises in a team setting is inevitable and might affect how a student views TBL. Less use of planned material and direct feedback toward desired learning objectives switches the facilitator's role in the classroom from delivering content to recognizing student weak areas and offering follow-up questions, same observation was reported by Huang et al too[16].

Along with team-building activities, facilitators should be able to resolve such conflicts by establishing ground rules before the session and giving constructive criticism and feedback when the session ends. Immediate feedback is essential for knowledge retaining, influences team development, and fosters competitiveness between individuals and teams[17]. To prepare medical students for future teamwork, one crucial component of team-based learning is to increase their belief in the value of group discussions as a method for completing intellectual tasks[18]. While doing focused discussions, students had to answer

their classmates' queries, they had to explain the material to their peers and resolve discrepancies in their comprehension, which improved their learning. The facilitator plays a major role in building students' capacity to recall content over time which was further improved by assignments that required them to use higher-order thinking abilities such as problem-solving[19]. In a study by Schynoll et al, students reported that their critical thinking abilities greatly improved in a TBL environment compared to conventional courses for the majority of the skills assessed, and significantly improved in all of these skills compared to lecture-based courses which is in line with our study[20]. People rarely have the chance to forgo preparation and participation in group activities in the TBL setting. Students observed that TBL requires more preparation for a higher-quality of class discussion. Preparation time for students was the only measure in our study which scored the lowest rating. With this study, our doubt and apprehension were overcome by the encouraging feedback from the students. Not only did they show their preference for TBL as an effective teaching strategy but also sparked their excitement for group discussion, critical thinking, and problem-solving as a team member[21]. When students cooperate consistently, they develop into cohesive learning teams that can properly evaluate and utilize the resources of each member of the group.

Our results show TBL as an enhancing tool for students` engagement during group discussions and problem-solving skills, meanwhile, students take TBL as a difficult and time-consuming strategy of learning, as results also show that TBL requires more time for preparation. One major pitfall of TBL is associated with students' lack of enthusiasm when shifting to a different learning method, and heavy workload due to the flipped classroom format[22]. Decision-making by students takes more time while going through different steps of the learning process and students rate this activity that consumes hours, as in our study. A study by Burgess et al conducted at Sydney Medical School also reported that insufficient peer engagement, variable expertise, and facilitator enthusiasm might be a few contributing factors[23].

Our students' perceptions of the weaknesses and limitations of TBL are similar as revealed in literature, and we need to adopt the principle to plan the activity or task well, taking into account the nuances of human interaction, the mix of personalities, and course the learning styles of your group[24]. There is a dire need to introduce key features of TBL principles and practices in the TBL sessions, including appropriate allocation of students into groups to create diversity, preparedness of pre-reading material before the session, prescribed execution of individual response assessment test (iRAT) and team response assessment Test (tRAT), feedback, and application exercise with all students at the end of the session[25].

When presented with open-ended questions on a questionnaire about the relative benefits of problem-solving skills and engagement/group discussion, students reiterate the opinion that TBL facilitates the sharing of their prior knowledge and concepts through group discussions rather than problem-solving skills. The second reason is that TBL instances are shorter and take less time, which can increase student engagement through group discussions. The ability to solve problems takes more time and requires more subject specialists.

CONCLUSION

Team-based learning based on a collaborative type of teaching encouraged our students to share their past knowledge and concepts through group discussions. Our study concluded that student's engagement was enhanced by TBL by working in small groups as team members which promotes cooperation, communication, and settlement of disputes or disagreements in the presence of facilitators. Compared to problem-solving ability, students' engagement was more successfully reported in our study.

ACKNOWLEDGEMENTS

None.

ETHICAL APPROVAL

Our study was approved by the institutional review board (Ref No: FRPMC-IRB-2023-26).

CONFLICT OF INTEREST

There was no conflict of interest involved in this study.

AUTHORS CONTRIBUTIONS

SK: Research Question, initial concept, Manuscript writing (Intro writing), Document editing, correction after review. MFR: Manuscript writing (Discussion writing), correction after review, References. SQB: Questionnaire Designing, Manuscript Writing (Method and Result Section). MAS: Data Collection, Data Analysis, Writing Result section and conclusion. Tables and Graphs, Final review and References. TA: Language checking and editing of the document. SH: Data Collection, Data Security, Literature search, extraction of research articles related to the topic.

REFERENCES

1. Burgess A, Haq I, Bleasel J, Roberts C, Garsia R, Randal N, Mellis C. Team-based learning (TBL): a community of practice. BMC Med Educ. 2019;19(1): 369. doi: 10.1186/s12909-019-1795-4.
2. Burgess A, van Diggele C, Roberts C, Mellis C. Team-based learning: design, facilitation, and participation. BMC Med Educ. 2020;20(Suppl 2):461. doi: 10.1186/s12909-020-02287-
3. Burgess A, Kalman E, Haq I, Leaver A, Roberts C, Bleasel J. Interprofessional team-based learning (TBL): how do students engage? BMC Med Educ. 2020;20(1):118. doi: 10.1186/s12909-020-02024-5.

4. Sterpu I, Herling L, Nordquist J, Rotgans J, Acharya G. Team-based learning (TBL) in clinical disciplines for undergraduate medical students scoping review. BMC Med Educ. 2024;24(1):18. doi: 10.1186/s12909-023-04975-x.
5. Zhang Q, Tang X, Zhao Y, Wang Z. Team-based learning vs. lecture-based learning in nursing: A systematic review of randomized controlled trials. Front Public Health. 2023;10:1044014. doi: 10.3389/f-pubh.2022.1044014.
6. Crow J, Smith L. Using co-teaching as a means of facilitating interprofessional collaboration in health and social care. J Interprof Care. 2003 Feb;17(1):45-55. doi: 10.1080/1356182021000044139.
7. Kim Y, Choi H. Beginning of outcome-based medical education: development of medical schools' mission statements based on stakeholders' priority. Korean J Med Educ. 2021;33(3):215-226. doi: 10.3946/k-jme.2021.201.
8. Korayem GB, Alghamdi AA, Aljuhani O, Ivy D, Alhubaishi AA, Alkofide H. Team-based learning versus traditional teaching effect on pharmacy Students' Performance: A systematic review and Meta-Analysis. Saudi Pharm J. 2024;32(4):102017. doi: 10.1016/j.-jsps.2024.102017.
9. Janke KK, Bechtol RA, James S, Lepp G, Moote R, Clapp P. Determining Indicators of High-Quality Application Activities for Team-Based Learning. Am J Pharm Educ. 2019;83(9):7109. doi: 10.5688/ajpe7109.
10. Langer AL, Binder AF, Scigliano E. Long-term Outcomes of team-based learning. Clin Teach. 2021;18(3):290-294. doi: 10.1111/tct.13332.
11. Boparai JK, Singh S, Kathuria P. How to Design and Validate A Questionnaire: A Guide. Curr Clin Pharmacol. 2018;13(4):210-215. doi: 10.2174/1574884713666180807151328.
12. Ledger S, Bin YS, Nour M, Cistulli P, Bauman A, Allman-Farinelli M, Naismith SL, Stamatakis E, Caillaud C, De Chazal P, Simpson SJ. Internal consistency and convergent and divergent validity of the Liverpool jetlag questionnaire. Chronobiol Int. 2020;37(2):218-226. doi: 10.1080/07420528.2019.1704771.
13. Nawabi S, Javed MQ, Bilal R. Problem-based Learning and Team-based Learning as a Novel Package Approach. J Coll Physicians Surg Pak. 2021;31(6):710-715. doi: 10.29271/jcpsp.2021.06.710.
14. Whillier S, Lystad RP, El-Haddad J. Team-based learning in neuroanatomy. J Chiropr Educ. 2021 Oct 1;35(2):184-191. doi: 10.7899/JCE-19-25.
15. Epsey M,. Enhancing critical thinking using team-based learning. Higher education Research and Development. 2018;37: 15-29.
16. Huang CY, Wang YH. Toward an Integrative Nursing Curriculum: Combining Team-Based and Problem-Based Learning with Emergency-Care Scenario Simulation. Int J Environ Res Public Health. 2020;17(12):4612. doi: 10.3390/ijerph17124612.
17. Burgess A, Matar E, Roberts C, Haq I, Wynter L, Singer J, Kalman E, Bleasel J. Scaffolding medical student knowledge and skills: team-based learning (TBL) and case-based learning (CBL). BMC Med Educ. 2021;21(1):238. doi: 10.1186/s12909-021-02638-3.
18. Chytas D, Noussios G, Paraskevas G, Demesticha T, Protogerou V, Salmas M. Incorporation of team-based learning in the cadaveric anatomy laboratory: An overview. Morphology. 2023;107(357):176-181. doi: 10.1016/j.morpho.2022.09.001.
19. James S, Cogan P, McCollum M. Team-Based Learning for Immunology Courses in Allied Health Programs. Front Immunol. 2019;10:2477. doi: 10.3389/fimmu.2019.02477.
20. Schynoll G, Perog J, Feustel PJ, Smith R. Curriculum Transition From Lecture-Based to Team-Based Learning is Associated With Improved Performance on Internal Medicine In-Training Examination. J Grad Med Educ. 2021;13(5):691-698. doi: 10.4300/JGME-D-20-01164.1.
21. Burgess A, Roberts C, Ayton T, Mellis C. Implementation of modified team-based learning within a problem based learning medical curriculum: a focus group study. BMC Med Educ. 2018 Apr 10;18(1):74. doi: 10.1186/s12909-018-1172-8.
22. Andersen EA, Strumpel C, Fensom I, Andrews W. Implementing team based learning in large classes: nurse educators' experiences. Int J Nurs Educ Scholarsh. 2011.doi: 10.2202/1548-923X.2197.
23. Burgess A, Roberts C, Lane AS, Haq I, Clark T, Kalman E, Pappalardo N, Bleasel J. Peer review in team-based learning: influencing feedback literacy. BMC Med Educ. 2021;21(1):426. doi: 10.1186/s12909-021-02821-6.
24. Yeung MM, Yuen JW, Chen JM, Lam KK. The efficacy of team-based learning in developing the generic capability of problem-solving ability and critical thinking skills in nursing education: A systematic review. Nurse Educ Today. 2023; 122:105704. doi: 10.1016/j.nedt.2022.105704.
25. Mulugeta H, Zemedkun A. Implementation of Team-Based Learning for a Clinical Module of the Ethiopian Undergraduate Anesthesia Curriculum and Students' Perspectives: A Pilot Cross-Sectional Study. Adv Med Educ Pract. 2023; 14:1413-1424. doi: 10.2147/AMEP.S437710.