Original Article

Impact of Team-Based Learning on Academic Performance of Physiotherapy Students

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Abstract

Background: Team-Based Learning (TBL) is a cutting-edge teaching strategy that aims to raise student involvement and boost academic performance. The effect of TBL on student performance is not well understood in the context of health professions education, especially in physical therapy schools. Objective: The main objective of this study was to determine whether third-year DPT students' academic performance is significantly impacted by TBL. To determine the difference in the performance of students by calculating the scores of students who learned the assigned module through the team based learning versus who learned the assigned module through small group discussion.

Methods: A Quasi-experimental cross-over study was conducted at Ali-Ul-Murtaza Department of Rehabilitation Sciences, Muhammad Institute of Medical and Allied Sciences, Multan, Pakistan from Febraury-May 2024. All students of DPT (Doctor of Physiotherapy) studying in third year were grouped to small group discussion and team based learning for 6 themes in a five week-course. After 3 themes' groups were flipped. The Team-Based Learning (TBL) methodology was conducted following the guidelines of AMEE Guide No. 65. For data analysis, we used SPSS version 23 and p-value less than 0.005 was considered significant.

Results: The obtained scores of students at the end of the module showed that there was the slight difference in student scores i-e students obtaining knowledge through team based learning scores good than students gaining knowledge through small group discussion in themes 1-3 (TBL 45.16±8.7 versus SGD 40.9±9.15,p=0.003) However, in themes 4-6 there was significant difference between mean scores of both groups i-e in themes 4-6 (TBL 49.13±8.94 versus SGD 41.93±9.49,p=0.001) as TBL being more effective and engaging for students.

Conclusion: This study demonstrates that Team-Based Learning has a positive impact on the academic achievement of third-year DPT students. Enhanced performance in both tests and assignments supports the assumption that TBL stimulates deeper learning and higher engagement.

Introduction

Team-based learning (TBL) is structured form learning for small groups in which this small group compromises of 5-7 students those studies as a team out of class and presentation of knowledge in the class.[1,2] This

instructional strategy was developed by Dr. Michaelson in 1990s when he found difficulty in lectures giving to class of a large number of students.[3] TBL is different from small group discussions (SGD) as being more productive and effective. TBL is considered easy to apply as there is no demand of multiple faculty and rooms, no expert is needed, and the only need is collaborative and productive behavior of students.[4,5] It also does not pressurize the students with high scores to perform more or lonely. TBL is classified by three main keys i-e Individual preparation, Individual and team readiness assurance test (tRATs), In class devoted to decision-based assignments.[6]

Team-based learning session is directed in the method of activities performed in the sequential way as individual readiness assurance test (i-RAT), team-readiness assurance test (t-RAT), and instructor clarification/mini T lecture and team application exercise[7] (t-App). Many studies showed that the effect of TBL on student's performance to relate knowledge are highly positive and are accountable to its process.[4] A study on TBL noticed that there was a more pronounced positive effect of TBL in students with the lowest academic scores.[5] A study on TBL was applied in embryology and gross anatomy courses and results showed that with the introduction of TBL the class average did not improve.[8] Wiener et al. conducted a study and results showed that great performers were benefitted greater by the TBL strategy.[9] Literature and evidences shows that TBL facilitates students to get benefit from the knowledge and from the learning styles of other group members, therefore teaching the ability to review and expand their own learning by improving themselves.[10]

Small group discussions are an integral part of Doctor of Physical Therapy (DPT) student education as they promote active learning, critical thinking, and collaborative problem-solving. Small group discussions enable students to discuss in-depth challenging clinical cases, exchange varied views, and reinforce their knowledge of important physiotherapy principles.[11] Through peer-to-peer interaction, students acquire effective communication and teamwork skills, which are essential for clinical practice. Moreover, discussions in small groups provide a learner-friendly environment through which students may clarify their misgivings, relate theories to practical circumstances, and hear constructive criticism both from peers as well as facilitators.[12] It is this engagement-based process which ultimately enables students of DPT to gain both confidence and efficiency in patient-centred care.

Collected works on medical education of Pakistan presented that if we use TBL as an instructional strategy it will greatly favor our system as results showed that students' satisfaction level greatly increases when traditional lectures were substituted by TBL.[13] Hashmi showed the altered method of TBL and a comparison was made with the traditional lecture to evaluate the benefits of TBL on students' performance and its effects on students' scores.[10] Badar et al. evaluated a study at Punjab Medical College in Faisalabad by obtaining students' remarks about TBL in comparison to lectures.[14]

Complexity in an interdisciplinary curriculum requires DPT education to utilize innovative teaching techniques. DPT students need to study a variety of subjects from medicinal physiology to kinesiology , all while developing the competencies necessary for clinical decision-making and effective communication with patients. Third-year DPT students face an integration challenge-to take foundational knowledge and combine it with emerging professional skills. At this point in their study, students need active-learning techniques like TBL, specifically focused on fostering critical thinking and team collaboration as a means of putting theoretical ideas into practice in realistic settings.

The theoretical backbone of TBL relies heavily on constructivist learning principles, where the students actively construct knowledge through collaboration and problem-solving.[15] The process generally includes: pre-class preparation, individual readiness checks, teamwork, and application exercises aimed at working problems similar to those in real life. Such a structure not only enhances personal responsibility but also leverages the collective intelligence of teams to tackle complex problems.[16] TBL has been demonstrated time and again in research to increase students' interest, academic achievement, and student satisfaction in different learning environments.

TBL is increasingly being adopted in DPT education worldwide as institutions seek to provide students with the skills needed for effective clinical practice. DPTs are often members of multidisciplinary healthcare teams, and teamwork and communication are essential components of patient care. Therefore, TBL fits well within the practical realities of the practice, and allows students to improve and hone such skills in an organized and safe learning environment. Studies have proven that students taught using TBL perform better in critical thinking and problem-solving along with retention of complex information which are some key areas for aspirant pharmacists. Muhammad Institute of Medical and Allied Sciences has been following the strategies of instruction which includes problem-based learning

(PBL) and small group discussions (SGD).

Team-Based Learning (TBL) is an active learning methodology that fosters team work, critical thinking, and application. Conventional lectures and small group discussions, however, are typically based on passive learning and individual student performance. TBL engages students by utilizing peer instruction, readiness assurance tests, and team application exercises. Its effect on academic performance in physiotherapy education has not been extensively studied. This research seeks to fill the gap. To determine the influence of Team-Based Learning in terms of the academic achievement of physiotherapy students in comparison with conventional small group discussion strategies.

Methods

A quasi-experimental, crossover study was done at Muhammad Institute of Medical and Allied Sciences after approval obtained from the Institutional Review Board (MIMAS/08/26/Maliha). We involved almost all the class of third year, DPT of was started. The study was conducted from February- May 2024. Students were initially divided into three levels of performance — above average, average, and below average— using their percentage scores in the last modular exam. The sample size was calculated using G*Power software (version 3.1.9). A priori power analysis for an independent t-test (two-tailed) was conducted to detect a statistically significant difference in academic performance between the TBL and SGD groups. The analysis assumed an effect size (Cohen's d) of 0.5, a significance level (α) of 0.05, and a power ($1-\beta$) of 0.80. Based on these parameters, the required sample size per group was calculated number, e.g., 62. Participants were then selected from this population using non-probability sampling and later randomly assigned to Group A (30 students) or Group B (30 students) for intervention by lottery method illustrated in figure 1. Exclusion criteria included students who missed over state percentage, e.g., 20% of the TBL or SGD sessions and who did not provide consent to participate in the study. Students with medical or personal reasons that precluded full engagement in class activities were excluded.

Transfer or exchange students who entered the program late in the module. For teaching students of third year DPT, instructional strategy i-e TBL was used instead of SGD for a five-week Cardiovascular Module. CVS module was planned along six themes. Throughout the session the performance of students was calculated. Each theme orbited around real-life contextual cases that acted as stimulator. Our TBL team consisted of highly professional and dedicated members' i-e an Assistant Professor of Physiology as module director, the principal investigator (PI), and a PhD Scholar in CVS Physiology. The curricular concepts were delivered through team-based learning, skill lab discussions and sessions and small group discussions, large group sessions. Areas like gross and microscopic anatomy, developmental and clinical anatomy and applied physiology were addressed. We had done assessment by short answer questions and also by type A-items. For TBL assessment was done only by type-A items.

Firstly, we conducted a session in which students were briefly explained about TBL strategy. This session was conducted by principle investigator. Then, students were also advised to remain keep and calm, cooperative and disciplined. TBL sessions were conducted exactly in accordance to the AMEE guide No. 65.[17] It was mentioned earlier to the students that their scores were used for study and their informed consent was obtained. A handout about TBL strategy and about marking pattern was also given to students.

On the first day of cardiovascular module a power point presentation was also presented to class. Each and every activity was scored during every session of TBL and all these scores were considered as internal assessment. For both TBL and SGD duration of sessions and learning objectives were same. Learning objectives were shared in the format that was easily accessible for every student i-e by hard copies. For consistency, TBL and SGD sessions were delivered in a systematic protocol. Facilitators were previously trained in session delivery, scoring, and learning objectives adherence. The session length was set, and for both TBL and SGD, the same learning objectives were used. All exercises, including readiness assurance tests (RATs), team application exercises (t-app), and class discussions, were scored consistently across each session, and these scores were used for internal assessment. Learning material was provided to students uniformly in hard copy form, so all students had equal access to the same material. There was regular supervision by senior faculty to ensure that the protocol was being followed and uniformity was being maintained across sessions. During the study, all participants attended scheduled sessions, and their activities were scored consistently. Follow-up was maintained throughout the module, with weekly monitoring of attendance, participation, and assessment completion.

Small group discussions were done by exchanging and discussing concepts with each other and with faculty members. The discussion with faculty member helped students in achieving their objective. The faculty

member was supposed to interfere when it was required; involve discreet students, gave assistance or elucidates concepts when required. The facilitator evaluated each SGD on the "learner's log" through a global rating scale.

An end of module written examination consisting of an MCQ paper was designed by the subject expert. All questions of examination paper were organized in accordance with the sequence of themes and this paper was reviewed before printing by editorial staff of Ali-Ul-Murtaza Department of Rehabilitation Sciences to avoid any technical flaws. The paper consisted of 60 MCQs containing 10 MCQs of one theme and majority about 70% were of type-A. At the end of module percentage scores of last MCQ examination paper were collected. We used SPSS-23 for statistical analysis. Independent sample t-test was used for comparison of cumulative scores of both groups and mean scores for categories of both groups. The p-value less than 0.05 was considered significant.

Results

Table 2 presents the sociodemographic and academic profiles of students in Group A and Group B (n = 30 each). Both groups consisted of 12 students with average scores, 4 less than average, and 14 more than average. Gender, age, residence, parental education, living circumstances, extracurricular participation, exposure to TBL before the study, and study time were similar between the groups, providing balanced baseline characteristics for equitable comparison. The statistical values are shown in Table 3 below. At the end of the first half of CVS module (Themes 1-3) by overall calculating and comparing mean percent scores showed that students participating in TBL performed better than other group i-e SGD but the difference is significant and the students who gained knowledge through TBL scores more than those who gained knowledge through SGD. The disparity was less evident in the first half of the module (Themes 1–3; $p = 0.03$, Mean $\pm$ SD: TBL 45.16 ± 8.7, SGD 40.9 ± 9.15) but increased in the second half
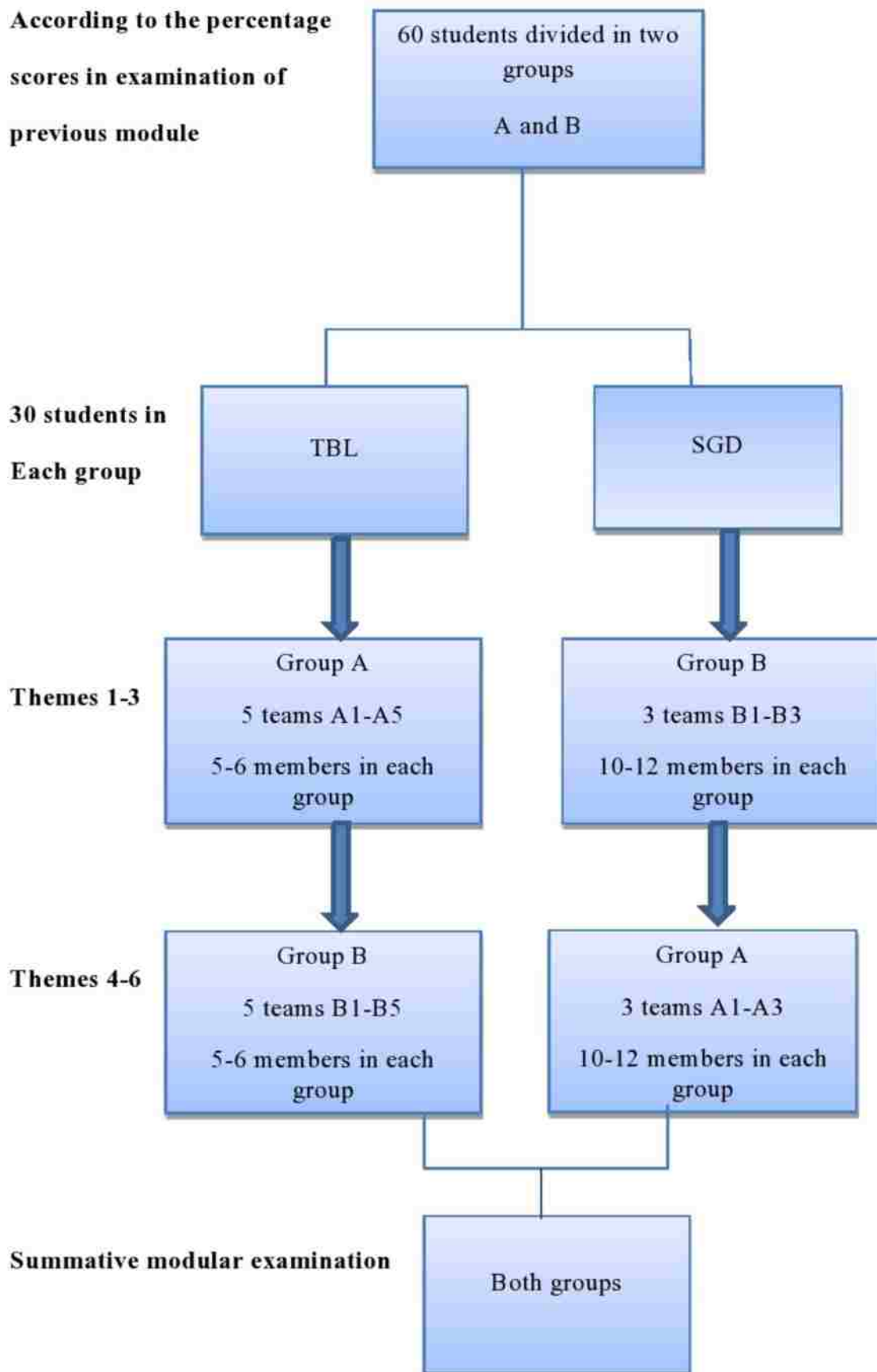
(Themes 4–6; $p = 0.01$, Mean $\pm$ SD: TBL 49.13 ± 8.94, SGD 41.93 ± 9.49). The comparison of mean scores of students falling in three categories i-e average, below average and above average showed that students of TBL group scores higher than the other group but the difference was statistically significant. During the first half of module Group-A learned the module i-e themes (1-3) through TBL and Group-B learned through SGD and in the third half Group-A learned through SGD

Table 2: *Classification of students on the basis of previous scores and socio-demographic data*

Characteristics	Group A (n=30)	Group B (n=30)
Previous Scores		
Average	12	12
Below Average	4	4
Above Average	14	14
Gender		
Male	10	13
Female	20	17
Age (years)		
18–20	9	8
21–22	15	16
>22	6	6
Residence		
Urban	17	15
Rural	13	15
Parental Education		
Graduate or above	12	11
Intermediate/High School	18	19
Living Arrangements		
With family	21	20
Hostel/Shared	9	10
Extracurricular Activities		
Yes	14	15
No	16	15
Previous Exposure to TBL		
Yes	4	5
No	26	25
Self-Reported Study Hours per Week		
<10 hours	9	8
10–15 hours	18	19
>15 hours	3	3

Table 1: *Overview about themes, numbers of TBL sessions*

	Group A	Group B
Themes learnt with TBL	1-3	4-6
	Patients suffering from hypertension	Patients with abnormal pulse
	Patients suffering from stroke	Patients suffering with angina pectoris
	Patients after MI	Patients with varicose veins
TBL session numbers	6	6

Table 3: *: Comparison of the mean scores of students of both group (TBL and SGD)*

Themes	Parameters	Mean± S.D	p-value
1-3	TBL (Group A)	45.16±8.7	**0.03**
	SGD (Group B)	40.9±9.15	
4-6	SGD (Group A)	41.93±9.49	**0.01**
	TBL(Group B)	49.13±8.94	

According to the percentage scores in examination of previous module

60 students divided in two groups

A and B

30 students in Each group

TBL

SGD

Themes 1-3

Group A

5 teams A1-A5

5-6 members in each group

Group B

3 teams B1-B3

10-12 members in each group

Themes 4-6

Group B

5 teams B1-B5

5-6 members in each group

Group A

3 teams A1-A3

10-12 members in each group

Summative modular examination

Both groups

Figure 1: *Flow chart depicting the division of students into two groups for Team Based Learning (TBL) and Small Group Discussion (SGD)*
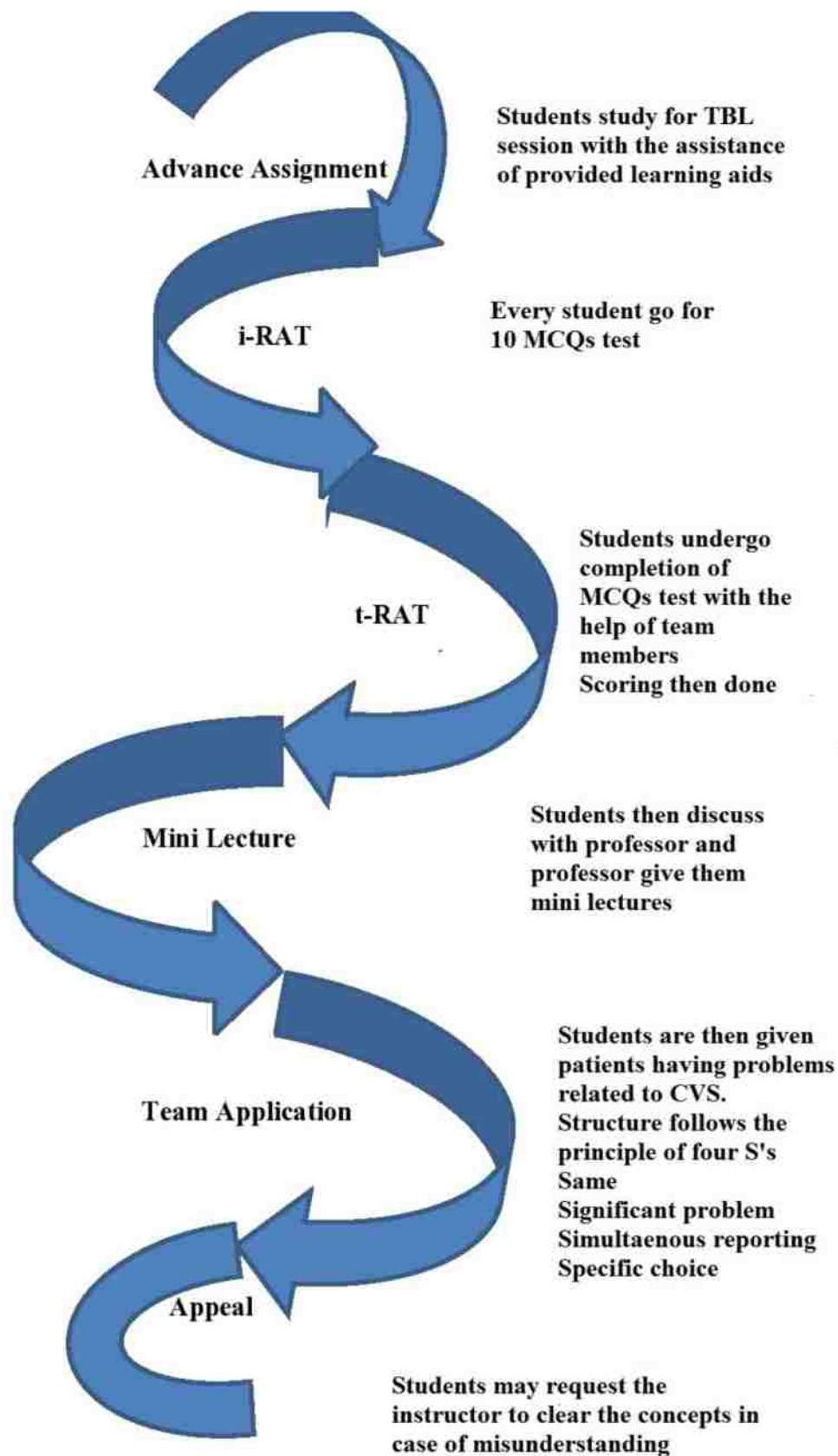
Figure 2: *Flowchart illustrating the Team-Based Learning (TBL) process, including stages from advance assignments, individual and team readiness assurance tests (i-RAT and t-RAT), mini lectures, team application exercises, and the appeal process for clarifying misunderstandings.*

learned the next three themes (4-6) and Group-B learned through TBL. At the end of learning session of last three themes scores of both of the groups were compared and it showed that scores of students learned through TBL were higher than scores of other group. The comparison of the scores of last three themes indicated the same leaning as shown in 1-3 themes in which there was a statistically significant difference in the mean scores i-e TBL students performed better than SGD students. Students who gained knowledge through TBL scores more than SGD in both halves.

Discussion

The research conducted applied Team-Based Learning (TBL) and proved that it had a positive influence on student performance. Students in TBL had higher scores than students under the Small Group Discussion (SGD) category. The disparity was less evident in the first half of the module (Themes 1–3; $p = 0.03$, Mean $\pm$ SD: TBL 45.16 $\pm$ 8.7, SGD 40.9 $\pm$ 9.15) but increased in the second half (Themes 4–6; $p = 0.01$, Mean $\pm$ SD: TBL 49.13 $\pm$ 8.94, SGD 41.93 $\pm$ 9.49). Both cohorts utilized a standard syllabus with identical learning outcomes and study time. Although these have been noted to be similar, the first part of the module proved to be more difficult in that it required comprehension of simple concepts and hence scored lower. The second part contained more applied physiology, allowing students to comprehend and use concepts more easily and hence scoring better. Variations in SGD scores can also result from facilitator competence and experience and levels of student engagement.

Students of the TBL group were required to complete home work associated with practical situations, promoting increased understanding and motivation as opposed to SGD. All these aspects could be responsible for the disparity in scores of students. Small group learning is simple to implement since it is dependent on facilitator skills, and all subjects were discussed among students, enabling interaction and concept clarification. Two other important features of peer teaching and accountability inherent in TBL are behind its positive outcomes. TBL tests students' capabilities and allows them to think deeply and assess their performance thoughtfully.[17] Peer assessment at the conclusion of each half of the module contributed 5% to the overall TBL mark. Team application (t-app) exercises and individual and team readiness assurance tests (tRATs) instilled a feeling of teamwork, commitment, and motivation in the students.[18-21] All these resulted in a healthy environment of discussion as well as competition. Faculty members were crucial, as preparing MCQs for RATs and t-app exercises and giving lectures and sessions was difficult.[22]

These results agree with earlier published research. Multiple studies indicated that TBL enhances engagement of students, collaborative learning, and retention of knowledge compared to conventional or small group learning strategies.[17,18] For instance, TBL has been evidenced to improve problem-solving skills, clinical reasoning, and active participation of medical and health sciences students. Other evidence emphasizes that peer assessment and team-based evaluations lead to increased accountability and motivation.[21] SGD, however, relies heavily on personal effort and guidance by the facilitator, which can restrict its application.[22]

SGD differs from TBL in that it relies mainly on individual performance, while TBL has positive impacts through teamwork. Students learning through SGD might not be encouraged to contribute as their grades will not necessarily be affected. Generally, TBL fosters accountability, teamwork, and active learning, resulting in improved outcomes.

The study was limited by non-random student assignment, potentially introducing selection bias. Variability among facilitators in SGD sessions might have influenced performance outcomes, and the study period covered only one module, so long-term retention and performance were not measured. Despite this, TBL was an effective teaching tool. It is suggested that TBL be incorporated more comprehensively into the curriculum to facilitate greater collaborative learning and critical thinking. Randomized designs for studies in the future, in addition to testing long-term retention of knowledge, should be employed, while faculty training on TBL facilitation should be uniform for ensuring standardized application across modules.

Conclusions

This research proves that Team-Based Learning (TBL) enhances the academic achievement of physiotherapy students over Small Group Discussion (SGD). Students in the TBL group scored higher mean marks in both the phases of the module, reflecting greater understanding, application, and retention of course material. The structured, interactive, and collaborative approach of TBL encourages more in-depth learning, analysis, and active participation. These findings indicate that the integration of TBL in the physiotherapy program can significantly enhance learning outcomes among students and better equip graduates for practice. The use of larger sample sizes and follow-up over longer periods is suggested to further investigate the long-term effect of TBL on

academic performance and professional capabilities.

Ethical Approval: The Institutional Ethical Committee of Muhammad Institute of Medical & Allied Sciences Multan approved this study vide Ref: MIMAS/ 08/ 26/ Maliha.

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IAK: Conception & design, final approval of the version to be published

MKK: Acquisition of data, drafting of article, final approval of the version to be published

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