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Impact of Team-Based Learning on Medical Students Academic Performance

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ABSTRACT

The effectiveness of different educational strategies in medical education is still essential to students' academic performance and satisfaction. **Objectives:** To determine the effect of Team-Based Learning versus Small Group Discussion (SGD) on academic outcomes for students in a medical curriculum. **Methods:** The study design was a quasi-experimental non-equivalent control group design involving 100 medical students divided into two groups of 50 for Team-Based Learning and 50 for Small Group Discussion. Data collection comprised pre-test and post-test scores, changes in scores, and levels of satisfaction measured using structured surveys. Statistically, independent t-tests were used to compare academic performance and satisfaction between the two groups. **Results:** The Team-Based Learning group had significantly higher post-test scores, 76.42 ± 9.14 as compared to the Small Group Discussion group, 68.00 ± 9.45. The difference in change scores was significant: 16.56 ± 7.50 for Team-Based Learning versus 9.24 ± 6.50 for Small Group Discussion, $p<0.0001$. Satisfaction levels were also higher in the Team-Based Learning group at 4.14 ± 0.88 than in the Small Group Discussion group at 2.94 ± 0.79, with a statistically significant difference $p<0.0001$. **Conclusions:** It was concluded that Team-Based Learning versus Small Group Discussion generated significant differences in the academic performance and satisfaction levels of medical students. Team-Based Learning appears to be a more effective teaching-learning strategy compared to Small Group Discussion in enhancing engagement and better learning outcomes in medical education.

INTRODUCTION

In the rapidly changing field of medical education, the demand for innovative teaching methods has increased significantly [1]. Traditional educational approaches usually fail to create the student engagement needed to maximize learning outcomes [2]. Studies show that healthcare education needs teaching approaches which build students' ability to think critically through group activities and interactive learning that supports essential clinical capabilities [3]. Academic success depends on these core competencies which also serve as essential preparation for students to navigate the diverse multidisciplinary healthcare domain. Team-based learning combines educational periods into one active unit that increases student collaboration and boosts educational accountability [4]. A study reported that by using Team-Based Learning (TBL) students' progress through higher cognitive levels by working together to solve problems [5]. Through this approach, students transform into active problem-solving since TBL maintains essential skills defined by 'The Accreditation Council for Graduate Medical Education (ACGME)' focusing on physician practice that demands teamwork and communication abilities [6]. TBL

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standardization creates equivalent educational results among various student cohorts. Various academic research has documented the successful ways TBL helps students develop meaningful learning experiences. Multiple research studies have proven that TBL creates better learning effectiveness and increased content satisfaction across different educational settings [7-9]. Additionally, TBL helps students retain information longer and understand deeper concepts through classmate participation [10]. Through a detailed evaluation, researchers found that TBL generates increased student engagement since the framework encourages active learning and student-driven examinations [11]. TBL stands out as a crucial method in medical education because its benefits support interactive learning of complex clinical concepts. The educational strategy of small group Discussion (SGD) persists as one of the most commonly implemented methods in medical courses. The impact of SGD on student learning depends on how effectively students work together and the operating standards achieved by their facilitator [12]. This study indicates that while the SGD lead to learning improvements in most cases it doesn't deliver complete outcomes because of its unstructured nature as compared to TBL frameworks [13]. Given the limitations of SGD, alternative approaches that combine structure with interactive learning, such as TBL, need to be explored to optimize academic outcomes.

This study aims to examine how TBL influences medical student achievement levels as well as educational satisfaction against the traditional SGD curriculum. Contrasting the academic effects of TBL-based and SGD-based medical education required extensive qualitative and statistical research. The research findings offer significant benefits to policymakers and educators who are working to advance medical education quality standards. Resolving healthcare challenges with evidence-based TBL teaching methods helps researchers create skilled and adaptable healthcare practitioners of the future.

METHODS

This study design was a non-equivalent control group with randomisation, a type of quasi-experimental conducted at Rawal Institute of Medical Sciences, to investigate the impact of TBL on the academic performance of medical students compared to SGD, from January 2018- January 2019, involving 100 medical students and was conducted following ethical principles outlined in the Declaration of Helsinki. The written informed consent was obtained from all participants before their inclusion in the study. All Participants were informed about the study objectives, procedures, potential risks, and benefits. Each participant received clear assurances about their choice to stay in the study being voluntary with complete freedom to withdraw at any time. All participants received guaranteed confidentiality protection with anonymous research data during the complete study period. A stratified random sampling technique was used for the experiment design which separated participants between the TBL and SGD groups. To minimise biases, stratification was performed based on basic demographic variables: gender, age, and academic background. Students received their group assignment through a random number generator which distributed them between two different groups in each academic division. During assignment, the technique used random selection in combination with stratification to achieve equitable respondent profiles across groups lowering the potential impact of confounding variables on the study. The inclusion and exclusion criteria were all students taking MBBS pre-clinical classes at Rawal Institute of Medical Sciences in (2018-2019) qualified to enrol in the study. The study analyzed participants who gave their informed consent and attended at least 80% of the TBL or SGD intervention sessions. Exclusion criteria helped preserve the study's result integrity. Students who had participated in TBL before in other classes were excluded from the research to minimize potential biases in results. A comprehensive and reliable dataset was established following the exclusion of participants who did not complete the pre-test, post-test assessments or satisfaction survey. The required sample size emerged from G*Power software computations that considered a 0.05 significance level with an 80% statistical power and a 0.8 effect size (Cohen's d). Test result evaluations performed on the same cohort served to calculate variance for objective consistency. Research data were collected from 100 medical students who were studying MBBS preclinical throughout the study duration. The detailed teaching guidelines that tutors used to deliver teaching methods reliably. During TBL sessions, tutors established a structured framework consisting of three phases preparation, individual testing then group collaboration followed by immediate responses. The facilitators of SGD sessions utilized standard scripts to maintain consistent discussion topics while controlling their facilitation methods and session lengths. Before conducting sessions facilitators received periodic training programs to become proficient with the standardized protocol and reduce variation in session delivery methods. The study team conducted periodic assessments of session documentation to confirm instructional consistency and received feedback from independent observers. These assessments verified that the instructional approaches were delivered as planned thereby reducing any bias that might result from variations in delivery style or method.

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These strategies helped the study maintain high levels of accuracy and reliability between the outcome measurements of the two tested groups. TBL Group Intervention: Students needed to complete advanced individual studies before commencing the lecture phases. Group activities combined individual assessment with team discussions where students collaborated to solve application-related questions. The facilitators followed each segment with real-time feedback to clarify confusion while strengthening comprehension. During SGD sessions students participated in instructor-guided group discussions about TBL-normative subject material. Students shared their comprehension by engaging in group discussions yet the instructor did not evaluate separate student quizzes. The research procedure was initiated with numerical assessments that were combined with human feedback methods. Students underwent both pre-test and post-test assessments through a special-purpose multiple-choice test instrument designed for this research project. The pre-test was conducted at the beginning of the year to assess baseline knowledge, while the post-test was administered at the end of the year to measure knowledge gains. Students answered multiple-choice questions about fundamental curriculum material to demonstrate their understanding of how previously learned information applies to professional scenarios. Multiple precautions were established to validate and ensure the accuracy of all assessments. The assessment established construct validity by measuring the intended cognitive domains, which included knowledge retention, critical thinking, and application skills. The evaluation of MCQ reliability used Cronbach's alpha to determine internal consistency among items. The pilot test involved students who participated in the study (n=30), during which Cronbach's alpha value of 0.82 confirmed good reliability in the MCQ test. Obtaining test consistency involved both evenly distributing questions across difficulty levels and implementing a standardized scoring system. A systematic approach was implemented to prove the reliability and validity of MCQ assessments and satisfaction survey tools, which enabled proper assessment of the intended outcome measure. In the end, a satisfaction survey was distributed to participants after completing the interventions. The survey included Likert-scale questions assessing different aspects of the learning experience: perceived effectiveness, engagement, and overall satisfaction with the learning method. The survey was unidentified to ensure honest feedback, and the data were aggregated for analysis. The survey's satisfaction level scoring was designed on the Likert scale, which typically ranges from 1 to 5, with 1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, and 5: Strongly Agree. For the scoring process, each student responds to the survey by selecting a number on the Likert scale that best represents their opinion for each statement. The scores for each item were recorded, allowing for quantification of satisfaction levels. Data analysis was performed using SPSS version 22.0 (Statistical Package for the Social Sciences). Descriptive statistics (means and standard deviations) were calculated for all variables. Independent t-tests were employed to compare the two groups' pre-test and post-test scores, change in scores, and satisfaction levels. A p-value of <0.05 was considered statistically significant.

RESULTS

Results show the participants were evenly distributed between the TBL and SGD groups, with 49% male and 51% female students. Most students (90%) were between 18 and 23 years old, with an equal distribution of those above 23 years in both groups. The mean high school science grade point average (GPA) was similar across groups (TBL: 3.8 ± 0.4; SGD: 3.7 ± 0.5). Prior exposure to active learning methods was reported by 22% of participants, slightly higher in the SGD group (24%) compared to the TBL group (20%) (Table 1).

Table 1 : Demographic and Academic Characteristics of Participants

Characteristics	TBL Group (n=50)	SGD Group (n= 50)	Total (n=100)
Gender			
Male	25 (50%)	24 (48%)	49 (49%)
Female	25 (50%)	26 (52%)	51 (51%)
Age (Years)			
18–20	20 (40%)	22 (44%)	42 (42%)
21–23	25 (50%)	23 (46%)	48 (48%)
>23	5 (10%)	5 (10%)	10 (10%)
Academic Background			
GPA (Mean ± SD)	20 (40%)	22 (44%)	42 (42%)
Prior Exposure to Active Learning	25 (50%)	23 (46%)	48 (48%)

Research shows the TBL group (59.86) had a slightly higher pre-test score than the SGD group (58.76), indicating a comparable baseline knowledge level. The TBL group outperformed the SGD group significantly, with a mean score of 76.42 versus 68.00, highlighting the effectiveness of TBL in improving knowledge retention. The TBL group's change in score (16.56) was nearly double that of the SGD group (9.24), emphasising the impact of TBL on learning gains. Students in the TBL group reported higher satisfaction (4.14) than the SGD group (2.94), suggesting that TBL enhances academic performance and improves student engagement and enjoyment of the learning process (Table 2).

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Table 2: Descriptive Statistics for TBL and SGD Groups

Groups	Pre-Test Score (Mean ± SD)	Post-Test Score (Mean ± SD)	Change in Score (Mean ± SD)	Satisfaction Level (Mean ± SD)
TBL (n=50)	59.86 ± 5.79	76.42 ± 9.14	16.56 ± 7.50	49 (49%)
SGD (n=50)	58.76 ± 6.37	68.00 ± 9.45	9.24 ± 6.50	2.94 ± 0.79

Analysis shows the means and standard deviations for pre-test scores, post-test scores, change in scores, and satisfaction levels. The t-test results show no significant difference ($p = 0.368$), indicating that both groups started at similar knowledge levels. An important difference was observed ($t=-4.528$, $p<0.0001$), confirming that TBL leads to higher post-test scores than SGD. The significant t-value ($t=-5.215$, $p<0.0001$) highlights that TBL substantially impacts student learning, resulting in greater knowledge gains. The significant positive t-value ($t=7.159$, $p<0.0001$) indicates that TBL is significantly more satisfying for students than SGD (Table 3).

Table 3: Independent t-test Results Comparing TBL and SGD Groups

Comparisons	T-Statistic	p-value
Pre-Test Scores	-0.904	0.368
Post-Test Scores	-4.528	<0.0001
Change in Scores	-5.215	<0.0001
Satisfaction Levels	7.159	<0.0001

The analysis of demographic subgroups Table 4 revealed that the TBL group consistently demonstrated greater improvements in test scores and higher satisfaction levels compared to the SGD group. Both male and female students in the TBL group showed significantly higher academic gains and satisfaction scores, with no major differences between genders. Younger students (18–20 years) achieved slightly higher improvements and satisfaction compared to older participants, indicating that TBL may particularly benefit this age group. Students with higher academic backgrounds (GPA >3.5) reported better outcomes with TBL in both test score improvements and satisfaction, suggesting that the structured nature of TBL aligns well with high-achieving students. However, the positive impact of TBL was consistent across all subgroups, emphasising its effectiveness as a universally applicable teaching method in medical education (Table 4).

Table 4: Change in Test Scores and Satisfaction Levels by Demographics

Variables	TBL - Test Score Change (Mean ± SD)	SGD - Test Score Change (Mean ± SD)	p-value (Scores)	TBL - Satisfaction (Mean ± SD)	SGD - Satisfaction (Mean ± SD)	p-value (Satisfaction)
Gender						
Male	16.8 ± 7.2	9.5 ± 6.1	< 0.001	4.12 ± 0.82	2.89 ± 0.78	<0.001
Female	16.3 ± 7.8	8.9 ± 6.7	< 0.001	4.15 ± 0.90	3.01 ± 0.79	<0.001
Age (Years)						
18–20	17.2 ± 7.5	9.0 ± 6.3	< 0.001	4.20 ± 0.85	2.91 ± 0.80	<0.001
21–23	16.5 ± 7.1	9.4 ± 6.5	< 0.001	4.10 ± 0.90	2.97 ± 0.77	<0.001
>23	15.8 ± 6.9	9.2 ± 6.2	< 0.001	4.08 ± 0.88	2.90 ± 0.79	<0.001
High School GPA						
Above 3.5	16.9 ± 7.4	9.7 ± 6.4	< 0.001	4.18 ± 0.86	2.95 ± 0.78	<0.001
3.0–3.5	16.0 ± 6.8	9.4 ± 6.5	< 0.001	4.07 ± 0.89	2.92 ± 0.80	<0.001

DISCUSSION

This study revealed valuable insights into the impact of TBL compared to SGD on medical students' academic performance and satisfaction levels. The results suggest that TBL significantly enhances post-test scores and overall satisfaction than SGD, highlighting the effectiveness of the educational strategy. The post-test score showed a significant difference between groups. Post-testing revealed that the TBL group earned a mean score of 76.42, and the SGD group obtained 68.00 as their mean. A substantial p-value of 0.0001 indicates that TBL reduces student confusion while ensuring deeper academic understanding. TBL's adoption of an active learning environment represents one possible reason for successful implementation. According to Børte *et al.*, and Owens *et al.*, active learning methods produce lasting student learning outcomes and academic achievement improvements [14, 15]. Data supported our findings through score change analysis because the TBL group demonstrated 16.56 points of improvement compared to 9.24 points for the SGD group. The improvement in student performance was demonstrated as statistically significant at p less than 0.0001, indicating that TBL enhances both content comprehension and deep engagement with educational material. A study by Burgess, in 2020 proved that the collaborative aspect of TBL where students explain concepts to peers, leads to better retention and comprehension of information [16]. The TBL educational method yielded better satisfaction levels in comparison to SGD ($p<0.0001$) as students achieved a mean satisfaction score of 4.14 versus 2.94. Student opinion indicates that

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TBL meets their satisfaction expectations. A study by Charalambous *et al.*, observed that the structured feedback provided during TBL sessions contributes to satisfaction. It helps students clarify misunderstandings and feel supported in their learning journey [17]. The satisfaction survey also showed that students in the TBL group appreciated the opportunity for peer interaction and the collaborative learning environment. Following the study, Sannathimmappa *et al.*, reported that students value active participation and collaboration in the learning process, leading to a more enjoyable and effective educational experience [18]. Our results are consistent with the development of literature that supports TBL as an effective educational approach in medical education [19]. Ainsworth *et al.*, Nawabi *et al.*, and Mansoor *et al.*, have shown that TBL enhances academic performance and improves student engagement and satisfaction [20-22]. A meta-analysis by Parappilly *et al.*, found that TBL was associated with better academic outcomes in different disciplines, including health sciences [23]. The findings of this study add to this literature by specifically focusing on medical students, demonstrating that TBL can be a superior alternative to traditional SGD methods. The implications of our study were significant for medical educators seeking to enhance learning outcomes and student satisfaction. Implementing TBL could improve academic performance, enhance engagement, and increase student satisfaction. As medical education progressively underlines the need for collaborative skills and critical thinking, TBL supports these educational goals well.

CONCLUSIONS

It was concluded that TBL significantly enhances academic performance and satisfaction levels among medical students compared to SGD, indicating that TBL promotes an interactive and collaborative learning environment, leading to better engagement and understanding of the material. As medical education progresses, integrating TBL into curricula could improve educational outcomes and prepare students for future clinical practice. It emphasises the importance of adopting innovative teaching strategies that promote active learning and collaboration, ultimately benefiting students' educational skills.

Authors Contribution

Conceptualization: ZA
Methodology: MK, AA, KA, SH
Formal analysis: ZA, BA
Writing review and editing: ZA, MK, AA, KA, SH

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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