

## Research Article



# Comparison of Lecture Based and Modified Team Based Learning in Achieving Cognitive Skills in Medical Education

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**Abstract** | Current study was designed to compare effectiveness of lecture-based and modified team-based learning in achieving cognitive skills in resident doctors.

**Methodology:** This comparative cross sectional study was conducted on medical floor in Mayo Hospital, Lahore. Resident doctors (RDs) including house officers (HOs) and postgraduate residents (PGRs) were divided into two groups for lecture based learning (LBL) and modified team based learning (mTBL) on the topic of “health promotion and disease prevention”. All RDs undertook individual readiness assurance test (IRAT) and final (FT) tests where FT pertained to six cognitive domains. Statistical testing for IRAT and FT scores and performance in early and advanced domains were performed taking p-value < 0.05 as significant.

**Results:** A total of 53 RDs including 58.49% HOs and 41.51% PGRs participated in the study with similar distribution among mTBL and LBL groups. The mean IRAT scores for LBL and mTBL groups were  $41.03 \pm 17.79$  &  $44.17 \pm 19.54$ , respectively (p-value 0.272). The overall FT scores were  $40.26 \pm 15.17$  &  $48.02 \pm 17.57$  for LBL and mTBL respectively (p-value 0.045). The FT scores in early domains were  $34.81 \pm 14.93$  &  $56.12 \pm 15.1$  for LBL and mTBL groups (p-value 0.000). The scores of advanced domains were  $35.53 \pm 12.65$  and  $30.56 \pm 14.73$  for LBL and mTBL (p-value 0.301). PGRs performed better than HOs in early domains (p-value 0.043) but not in advanced domains. There was no difference in performance of male and female RDs.

**Conclusion:** After a single session, mTBL significantly improved performance in early cognitive domains but not in advanced cognitive domains.

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## Introduction

Didactic lecture, the classical mode of dissemination of knowledge, was developed in ancient times by Great Greek Orators<sup>(1)</sup> and remains in practice today.<sup>(2)</sup> A large number of students could be taught simultaneously by a single teacher who is considered to be the source of knowledge. It is high-

ly valued for economic and logistic advantages but is considered a passive or teacher-centered mode of learning.<sup>(1)</sup> Due to limited interaction between teacher and learners, teaching becomes monotonous and boring and learners quickly lose interest. More importantly, the learning outcomes remain limited to memorization and at the most comprehension of knowledge unless the students are highly motivated.<sup>(3)</sup>

It is worth mentioning that higher order thinking skills (HOTS) are essential for progression in any professional field.<sup>(4)</sup> These skills enable the professionals to design and conduct research, write books, develop new concepts and critically appraise existing work.

Dr. Benjamin Bloom, an American educational psychologist, made great contributions to the development of mastery learning and exceptional talent for achievement of eminence and greatness. In 1956, the taxonomy of learning objectives was put forth under his leadership famously known as Blooms taxonomy<sup>(5)</sup> His aims were to enhance higher forms of thinking in education such as analysis and evaluation of concepts. This taxonomy has remained a fundamental element in the educational community since then.<sup>(4)</sup>

Bloom divided learning into three domains of cognition, affective and psychomotor skills. The cognitive domain was further divided into six categories (C1-C6) of knowledge, comprehension, application, analysis, synthesis, and evaluation.<sup>(4,5)</sup>

Since then efforts have been made to devise teaching methods to incorporate these superior qualities of cognition in students. In the medical field, the introduction of problem-based learning (PBL) in the late 1960s in McMaster University, Toronto, Canada is a notable example.<sup>(6)</sup> It is an active educational approach conducted in small groups in which learners are asked to solve open-ended problems by seeking key information. In this student centered approach, the teacher acts as facilitator.<sup>(6)</sup> This powerful mode of teaching remained limited in practice due to logistic reasons. Extensive faculty development and more physical space for small groups working independently were required.<sup>(7)</sup>

Dr. Larry Michaelson made another such effort. In 2005, he introduced team based learning (TBL) in business schools. It was an active learning strategy, relatively free of logistic problems.<sup>(8)</sup> It was later adopted in medical education as well.<sup>(1)</sup>

In this method, teaching is conducted in five steps. Basic learning material is provided to the students to prepare for the TBL session. At the start of the TBL session, the learners take an initial MCQ test, the individual readiness assurance test (IRAT). This is done to motivate and create sense of accountabil-

ity in each team member. The learners are then split into teams consisting of 5 or 7 members each. The same MCQ test is now answered after mutual discussion and developing consensus between the team members. This is called team readiness assurance test (TRAT). Finally, the teams are supposed to answer questions pertaining to practical application of newly acquired knowledge. The facilitator gives feedback immediately so that the students can rethink and realize their mistakes. The teacher then delivers a mini lecture to clarify misconceptions noted in the TRAT and to prepare the learners for the final most important step of practical application of newly acquired knowledge. The learners are then asked to answer relevant questions. All the teams are supposed to answer simultaneously and to explain and defend their choices to other teams. Thus, the learners are made to analyze and evaluate situations and are motivated to plan and synthesize, the capabilities vital for the progress of the profession.<sup>(8,9)</sup> TBL method allows flexibility and can be modified at every step depending upon the demands of the curriculum and approach.<sup>(10,11,12)</sup>

While TBL has gained popularity over the last decade, several disadvantages have been reported as well. Social loafing is one of them. This means that one or more members do not participate effectively in the teamwork. This leaves increased work load on the remaining members.<sup>(13)</sup> Moreover, the situation at the workplace might be different from the class room<sup>(14)</sup> Lack of adequate instructor preparation is also an important challenge.<sup>(15)</sup> In a systematic review, it was observed that medical students didn't prefer TBL to other teaching methodologies. In view of the authors, this might be due to increased workload and accountability.<sup>(8)</sup>

In Pakistan, the traditional didactic lecture is still the most popular and widely used mode of information transfer in medical education.<sup>(12)</sup> In theory classes. PBL and TBL have been introduced at very few places.<sup>(12)</sup> In King Edward Medical University, didactic lecture is the primary mode of information transfer for undergraduate medical education. PBL has been adopted for few courses but TBL has not been introduced as yet.<sup>(16)</sup> Furthermore, Fatmi et al in their systematic review of the effectiveness of TBL in health professions education found that studies focusing on critical thinking abilities and application of knowledge were limited and recommended the need for further research in this area.<sup>(8)</sup> They further comment-

ed that at present there is only preliminary evidence for utility of TBL on improving learning outcomes.<sup>(8)</sup>

In view of the existing scenario, this study was planned to compare the effectiveness of mTBL versus conventional lecture in achieving various cognitive skills.

## **Methodology**

This comparative cross sectional study was conducted in the Department of Medicine, King Edward Medical University, Lahore, Pakistan in April 2017 after approval from the institutional review board.

The study participants were 53 resident doctors (RDs) including house officers (HOs) and postgraduate residents (PGRs) who had been working on the medical floor for at least 2 months. Resident doctors who had previously done internship, house job or formal training in preventive medicine, preventive pediatrics or community medicine departments were excluded from the study. Non-probability purposive sampling was used to recruit the study participants. Written informed consent was taken after explaining the purpose of study and confidentiality was ensured. The participant RDs were randomly allocated to group 1 and group 2 using stratified random sampling technique with stratification being done based on designation i.e., HOs and PGRs.

Group 1 comprised of 29 RDs including 17 HOs and 12 PGRs while group 2 comprised of 24 RDs including 14 HOs and 10 PGRs. Group 1 was allocated for lecture based learning (LBL) while group 2 was assigned modified team based learning (mTBL). TBL was modified in three ways. Firstly, the participants were not given any reading material for pre-class preparation. Secondly, the TRAT was not conducted. Lastly, the FT was taken by individual participants rather than teams.

The theme selected for lecture and discussion in this study was "Disease Prevention & Health Promotion." This topic is included in the under graduate MBBS curriculum<sup>(17)</sup> and is formally taught in fourth year MBBS class in Community Medicine lectures and practical activities. During clinical years, the students, HOs & PGRs have the opportunity to apply this knowledge by counseling/advising the patients regarding adoption of healthy lifestyle and disease prevention measures. Due to the importance, appli-

cability, generality and broad scope of the subject, the authors were not only able to obtain sufficient material for the lecture and discussion but also had room for setting questions to test various cognitive domains. The lecture was prepared with mutual agreement between authors who also finalized the reading material for mTBL session. One of the authors was prepared and guided to deliver the lecture. Another author was trained by the research team to conduct the mTBL session including facilitation of discussion stage, identification of common problems and delivery of mini lecture as required by the participants. Both the LBL and mTBL sessions were conducted simultaneously in separate lecture halls.

Both group 1 and 2 undertook an initial test, the IRAT to assess the baseline knowledge of the participants. Group 1 attended the LBL session, which comprised of a 45 minutes' lecture utilizing audiovisual aids. 10 minutes were reserved at the end of the lecture for question & answer session to clarify any problems identified by the RDs.

Group 2 was further subdivided into 4 teams each comprising of 6 members including 2-3 PGRs and 3-4 HOs. Printed material was handed over to the teams for study. Discussion among the team members was encouraged to identify difficult areas. 45 minutes were allocated for this activity. The facilitator helped to sort out the problems that arose during the discussion. The facilitator compiled the problem areas identified by the team and delivered a 10 minutes' mini lecture addressing these areas.

Both groups were then administered a final test (FT) which was specially designed to assess all six levels of cognitive domain. The six cognitive domains were grouped as early including C1-3 and advanced including C4-6 levels. The ability of FT to test various cognitive domains was done by taking opinion from senior faculty members well versed in medical teaching.

All the data were transferred to a specially designed proforma and entered in SPSS-20.0 for analysis. Mean $\pm$  SD was calculated for continuous variables (age, IRAT score and FT score) and frequency distribution and percentages for categorical variables (gender and designation). Statistical comparison was done for IRAT and FT scores and performance in early and advanced domains. Independent sample t-test

for continuous variables and Chi-square test for categorical variables were used in the statistical analysis. P-value < 0.05 was considered significant in all the analyses done.

## Results

A total of 53 RDs including 31 (58.49%) HOs and 22 (41.51%) PGRs working on the medical floor of our hospital participated in the study. The RDs were divided into 2 groups; LBL (group 1) and mTBL (group 2). LBL group comprised of 17 (58.62%) HOs and 12 (41.38%) PGRs, while the mTBL group comprised of 14 (58.33%) HOs and 10 (41.67%) PGRs. The mean ages and gender distribution of the two groups were comparable as shown in Table 1.

The mean IRAT scores for the two groups before the activity are also shown in Table 1. Both the groups had comparable IRAT scores (p-value 0.272).

**Table 1:** Baseline characteristics of LBL and mTBL groups

Characteristics	LBL	mTBL	p-value
<b>Designation:</b>			
HOs (%)	58.49	58.33	0.983
PGRs (%)	41.38	41.67	0.983
Age – years (Mean±SD)	26.21±2.71	25.67±2.46	0.456
Gender – Males (%)	51.7	70.8	0.157
IRAT Score (Mean±SD)	41.03±17.79	44.17±19.54	0.272

The overall FT scores were 40.26 ±15.17 and 48.02 ±17.57 respectively for LBL and mTBL groups with p-value of 0.045, which was statistically significant. The FT scores were then analyzed for early and advanced cognitive domains. The FT scores in early domains were 34.81±14.93 and 56.12 ±15.1 for LBL and mTBL groups (p-value 0.000), which showed a significant improvement in mTBL group. The scores of advanced domains were 35.53±12.65 and 30.56±14.73 for LBL and mTBL groups, which did not show a statistically significant difference (p-value 0.301) (Table 2).

Comparison of IRAT and FT scores on the basis of designation showed that performance of PGRs was significantly better than HOs in early domains, but not in advanced domains as shown in Table 3.

Gender-based comparison revealed no statistical difference in performance of male and female RDs as shown in Table 4.

**Table 2:** FT scores of LBL & mTBL groups

Scores	LBL	mTBL	p-value
Overall	40.26±15.17	48.02±17.57	0.045
Early Domains	34.81±14.93	56.12±15.1	0.000
Advanced Domains	35.53±12.65	30.56±14.73	0.301

**Table 3:** Designation-based comparison

Scores	House officers	PGRs	p-value
IRAT	41.93±18.15	43.18±19.37	0.406
Overall FT	41.45±17.34	47.05±15.29	0.115
Early Domains	40.83±19.99	49.57±14.60	0.043
Advanced Domains	30.43±13.19	33.33±14.14	0.223

**Table 4:** Gender-based comparison

Scores	Male	Female	p-value
IRAT	45.31±17.96	38.1±18.87	0.083
Overall FT	44.06±18.80	43.33±12.97	0.438
Early Domains	45.41±16.21	43.01±21.49	0.322
Advanced Domains	31.25±15.58	32.22±9.96	0.400

## Discussion

In the present study, two modes of teaching were compared for learning outcomes in terms of cognitive skills in two groups of RDs. One group attended a conventional lecture while the second group was assigned a session of modified TBL. TBL is learner-oriented while LBL is teacher-oriented mode of learning. Furthermore, the performance of teams is better than individual members 97% of the time as described by Michaelson, the pioneer of TBL.<sup>(18)</sup> Therefore, modification of TBL, for the purpose of this study, enabled us to compare two entirely different modes of teaching. TBL modification is not a new concept; several authors have previously compared LBL and TBL in different ways.<sup>(10,11,12)</sup>

The number of sessions of TBL has been variable in previous studies. Hashmi compared the test score of a single lecture with that of a single session of modified TBL conducted three weeks later.<sup>(12)</sup> Hameed et al have compared two TBL sessions with eight

conventional lectures.<sup>(19)</sup> Bleske et al have compared TBL and LBL in a six weeks cross over model.<sup>(20)</sup> Jafari compared eight sessions of lecture with eight sessions of TBL in a neurology course.<sup>(21)</sup> We conducted a single session of mTBL in the present study. This was due to the fact that entire teaching schedule of undergraduate MBBS classes is planned at the outset of each academic year. It is not feasible to intercept it and conduct sessions of TBL until the medical education department implements it. Therefore, we conducted this study on our RDs who are at various stages of clinical training. Their future plans regarding choice of specialty, rotations to departments other than internal medicine and monthly duty schedules are variable. Therefore, we conducted a single session on a topic of common interest and importance. We intended to establish its usefulness before recommending it as another instructional methodology.

In our study, the overall performance of RDs was significantly better in the mTBL group (p value 0.045). In addition, they performed significantly better in early cognitive domains in the mTBL group (p value 0.00) whereas the performance was almost the same (p value 0.301) in the advanced cognitive domains. This observation is quite interesting and noteworthy. Bleske et al tested the cognitive domains of recall (C1) and application (C3) of knowledge. In both of these domains, TBL group performed significantly better.<sup>(20)</sup> This result is similar to our study where we observed a significant improvement in early cognitive domains (C1-3) in the mTBL group. Jafari used MCQs as assessment tool for lecture session while TBL sessions were assessed by IRAT and GRAT (group readiness assurance test) scores and reported superior outcomes in the TBL sessions.<sup>(21)</sup> She also noted that GRAT scores were significantly higher than IRAT.<sup>(21)</sup> This supports the philosophy that wisdom of crowd is superior to wisdom of individuals. Use of different assessment tools for the two methods of teaching might also have introduced a bias.

TBL was mainly designed to achieve higher order learning skills.<sup>(9,18)</sup> In our study, there was no advantage of mTBL over LBL in achieving these cognitive domains. There may be several reasons for this observation. We modified TBL session to enable the comparison of two different teaching methodologies. The FT was administered to individuals and not to the teams. The philosophy of TBL states that higher order thinking is facilitated by team input. Secondly, our

study results are based on a single LBL and mTBL session. Extension of TBL sessions may show the desired results. Lastly, we feel that our RDs have not been trained in higher order thinking skills (HOTS). They are taught by conventional lectures during most of their undergraduate studies in theory classes. Collins has suggested that HOTS are a skill to be developed like other skills and the teaching strategies must be targeted to develop HOTS.<sup>(4)</sup>

In this study, both groups of RDs comprising of HOs and PGRs were comparable at the outset as shown by the IRAT scores of LBL and mTBL groups (p-value 0.406). The FT scores of the two groups showed some interesting observations. The PGRs performed better than HOs in early domains of FT (p-value 0.043) but not in advanced domains (p-value 0.223). The result of early domains was expected, as the PGRs are at a higher level of knowledge and training than the HOs. The scores of advanced domains probably reflect that PGRs are not well trained in HOTS.

The overall performance of male and female RDs was comparable in the IRAT (p-value 0.083) and in both the early and advanced domains (p-value 0.332 and 0.400 respectively) in FT. This reflects that there is no discrimination based on gender in our institution. Other researchers have shown different results in this regard. In the LBL & TBL comparative study by Jafari, gender did not affect the scores in conventional lectures but the girls performed better in TBL sessions.<sup>(21)</sup> Wiener however showed contradictory results.<sup>(22)</sup> In that study although women were more satisfied with TBL, but in both initial and final examination, men achieved higher score in TBL.<sup>(22)</sup> It remains to be seen whether these differences reflect the different learning needs of the two genders.

## **Conclusion**

This study demonstrated that when compared to LBL, a session of modified TBL brought about a significant improvement in early cognitive domains. We propose that few sessions of TBL may be included in the undergraduate curriculum and further studies to be carried out to establish its efficacy and utility in the local context.

## **Author's Contribution**

**Quratul Ain Tahira:** Conceived the study design,

prepared learning material and lectures, collected and interpreted the data and drafted the manuscript.

**Sidrah Lodhi:** Helped the first author in designing the study, collection and interpretation of the data and drafting of the manuscript.

**Sajid Abaidullah:** Helped the first author in designing the study, collection of the data, reviewed the manuscript

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