



# The Impact of Modified Team-Based Learning on the Learning of Students in an Orthopaedic Course

Khalid Elfadil Husein<sup>1,\*</sup> and Elsiddig Elhadi Mahmoud<sup>1</sup>

<sup>1</sup>Department of Orthopaedic, Omdurman Islamic University, Omdurman, Sudan

\*Corresponding author: Assistant Professor, Department of Orthopaedic, Omdurman Islamic University, Omdurman, Sudan. Email: khalidelfadil.husein@gmail.com

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## Abstract

**Background:** This paper presents the results of a modified team-based learning (MTBL) in the Orthopaedic Department of the Omdurman Islamic University. It is a modification of the team-based learning (TBL) developed by Dr. Larry K. Michaelson, who explored the benefit of small group learning within large classes. TBL differs from other forms of small group work, which involves developing and using learning teams in large settings as an instructional strategy.

**Objectives:** The main difference between conventional TBL and MTBL is that students learn in small groups in a single large class with a single facilitator in conventional TBL. In contrast, in MTBL, students learn in separate small classes with different facilitators. In this study, we investigated the impact of MTBL on the learning of students in an orthopaedic course. Students' satisfaction and grades, following the MTBL for an orthopaedic class, were analyzed and compared to another batch of students in a conventional lecture learning strategy. The two batches were taught by the same faculty members.

**Methods:** The MTBL was implemented as a teaching method in orthopaedics and traumatology course in 2020. A total of 282 students were surveyed for their satisfaction with this new pedagogical approach, and 153 students responded to the questionnaire. We adopted a self-administered questionnaire answering on a five-option Likert scale. The five options represented the levels of agreement. At the end of the course, students' exam scores were compared to the results of their previous batch, in which teaching was carried out utilizing conventional lectures only (a total of 128 students).

**Results:** The results showed that the majority of the students involved in the study (66.5%) were satisfied with the MTBL. The students thought that it increases the long retention of knowledge and should be used more frequently in the curriculum, and they recommend it to other students. The analysis of the examination results using the Chi-square test revealed a significant difference between the results of the students who studied the course in the form of MTBL and those who studied the course in the form of a traditional lecture with a clear improvement in the results following MTBL orthopaedic course (P-value = 0.0000).

**Conclusions:** We, therefore, conclude that the MTBL where students are divided into separate small groups with different instructors improves the performance and the grades of the students in the exam. It also reveals that the students feel satisfied with the learning technique. We recommend it be more frequently used in the curriculum.

**Keywords:** Modified, Team-Based Learning, Orthopaedic Course

## 1. Background

Team-based learning (TBL) is defined as "an active learning and small group instructional strategy that provides students with opportunities to apply conceptual knowledge through a sequence of activities that includes individual work, teamwork, and immediate feedback". The goal of this strategy is the improvement of learning. Improvement of learning is a continuous and intentional revision in an academic program's learning environment. The researcher's aim is to reach an appropriate learning setting that produces better student learning achievement and helps in the retention of knowledge and skills by learners.

Since there are different types of classes and courses, and different students with a wide range of variations, regarding their skills, abilities, motivations, and interests, there must be different types of learning situations. In other words, there is no single best learning situation (1). In this process, the special context must be put into consideration where a learning method suits the target institute.

TBL is one of the learning situations with a positive effect on the outcome of the learning method. Teachers have reported that it improves students' performance and increases their grades. The students, on the other hand, have reported that it is an interesting method, which increases their critical thinking ability and makes the assessment of

the course easier (2).

In the early 1990s, Dr. Larry K. Michaelson, a professor of management at the University of Oklahoma, developed a new student-centered learning situation and named it TBL. The conventional TBL is applied as small group teaching, where multiple small groups interact in a large class under the guidance of a single facilitator. TBL has gained recent popularity in medical education (3). Kibble et al. at the University of Central Florida, College of Medicine, applied TBL in a class of 120 students (4). Rotgans et al., in their study, provided new insights into how TBL works from the student's perspective (5). Haidet et al. also used multiple small groups (generally five to seven learners per group) in a single classroom setting, usually with a single instructor (6). This way of application of TBL has many advantages. One of these advantages is the student/ teacher ratio, where a class of 200 students, for example, can be guided by one teacher during small group teaching. This may be helpful in the pre-clinical stage, where the shortage of teachers is experienced in many countries, including Sudan. In the clinical stage, where students are divided into separate small groups for clinical studies for history taking and clinical examination, TBL is seldom used. In the orthopedic department at Omdurman Islamic University, we started to apply TBL in separate small groups with different instructors. These are the same groups already made for clinical studies. The Faculty of Medicine at Omdurman Islamic University adopts the integrated curriculum, and the students in the clinical phase are divided into small groups (10 - 12) for clinical training. Modification of TBL is reported in the literature, but in different ways than ours. Inuwa et al. applied a modified team-based learning (MTBL), in which they used a computer-based evaluation followed by in-class activity (7).

In this study, we investigated students' satisfaction, as well as exam results, following MTBL, in an orthopaedic course. We assume that MTBL, in which students learn as teams in separate small classes with different facilitators, can provide similar outcomes as standard TBL.

## 2. Methods

This cross-sectional study was conducted in the Department of Orthopaedics and Traumatology at Omdurman Islamic University, among fourth-year students of the five-year program, from 2020 to 2021.

In this study, we investigated the impact of MTBL on learning of students in an orthopaedic course. Students' satisfaction and grades, following the MTBL for an orthopedic class, were analyzed and compared to another batch of students in a conventional lecture learning strategy. The two batches were taught by the same faculty members.

The department made a workshop to train its faculty for the new method and prepared PDF files for the topics that should be covered by the MTBL, and they were provided to the students on the first day. On the first day, an introduction to the course and a demonstration of the MTBL were provided.

The students read a topic selected by the instructor of the small group individually prior to the class. In the class, the small group was divided into two smaller groups (5 - 6 students each), and all the steps of TBL were done with a single facilitator, including the individual readiness assurance test (iRAT), team readiness assurance process test (tRAT), instructor clarification review, and the appeals.

A five-option self-administered questionnaire adopting a Likert scale with 13 questions was filled by the students after completing a modified orthopaedic TBL course.

The results of two different groups were analyzed using statistical package for social sciences (SPSS) version 18 and compared to each other. The first group was female students in batch 26. They were 128 in number, and they studied the orthopedic course for a duration of three weeks. Seven teachers, three of whom were part-time, participated in theoretical and clinical training. They studied the theoretical part through conventional lectures.

The second group was female students in batch 27. They were 182 in number and studied the orthopaedic course for a duration of three weeks. The same seven teachers who taught the previous batch participated in the teaching of this batch. The students studied the theoretical part through the TBL approach.

### 2.1. Study Area

The study was done at Omdurman Islamic University, Faculty of Medicine and Health Sciences. Omdurman Islamic University is built on an area of the size of about 800 feddans (3,360,000 m<sup>2</sup>) in Omdurman, Sudan. While the school is primarily oriented toward Islamic studies, it serves other fields of study, such as engineering, agriculture, and medicine.

The Faculty of Medicine was established in 1988, and 26 batches have graduated from the college. The main campus is in Alfitaihab Omdurman, and the college depends mainly on Omdurman teaching hospital for the clinical training of the students. The college has training and examination centers in this hospital.

### 2.2. Inclusion Criteria

Students who studied orthopedics and trauma course were selected.

A total of 153 students responded and filled out the questionnaire. The results of the final orthopedic exam for 310 female students were analyzed; 182 of them studied with TBL and 128 with conventional lectures.

### 2.3. Data Analysis

Data were analyzed using the SPSS version 18.

## 4. Results

A total of 153 students from the first batch who studied the orthopedic course in the form of MTBL responded and filled out the questionnaire, of whom 41 were males, and 112 were females, a number representing 73.2% (Table 1).

The results of the final TBL orthopedic exam for 182 female students were analyzed and compared to the scores of 128 female students of the previous batch who studied the course in the form of conventional lectures.

Based on the results of the present study, 67.9% of the students either agreed or strongly agreed that MTBL facilitates long retention of knowledge and 69.7% of the students agreed that MTBL helps to obtain a higher level of knowledge. Also, 77.2% of the students agree with the fact that MTBL effectively motivates the learning process, and 70% of the students agreed that MTBL fosters the use of critical reasoning and clinical problem-solving. Also, 43.8% of the students agreed that the amount of material is worth the time investment in MTBL, and 62.1% of the students agreed that they feel more comfortable when they compare MTBL to other non-lecture active methods.

In addition, 67.9% of the students reported that they feel more concentrated when comparing MTBL with other non-lecture active methods and 73.2% of the students agreed with the assumption that MTBL increases their contribution rate in sessions. Also, 73.9% of the students reported that MTBL makes the instructor more available, and 57.5% of the students agreed with the assumption that MTBL makes the session short.

In addition, 68.6% of the students agreed that MTBL should be offered more frequently in the curriculum, and 75.1% reported that they will recommend MTBL to other students. Also, 56.2% of the students were totally satisfied with MTBL.

In general, 66.5% of the students were found to either strongly agree or agree with the 13 components of the Likert scale, and they were satisfied with the MTBL, and they recommend MTBL to other students, and they agreed that it should be offered more frequently in the curriculum. On the other hand, 12.5% of the students were found either disagree or strongly disagree.

The analysis of the exam results using the chi-square test revealed the following results:

Nineteen students (10.4%) out of 182 in batch 27 scored A. The number of students who scored A in batch 26 was 4 (3.1%).

Also, 87 students (47.8%) out of batch 27 scored B+. The number of students who scored B+ in batch 26 was 38 (29.7%).

57 students in batch 27 scored B. The percentage is 31.3%. The number of students who scored B in batch 26 was 45 (35.2%).

Fifteen students (8.2%) in batch 27 scored C. The number of students who scored C in batch 26 was 34 (26.6%).

Four students (2.2%) in batch 27 scored F. The number of students who scored F in batch 26 was 11 (3.5%).

There was a significant difference between the results of the two batches (P-value=0.0000) (Table 2).

## 4. Discussion

Students' opinions about all aspects of academic life are now sought by educational institutions worldwide, generally, in the form of a satisfaction feedback questionnaire (8).

In the UK, higher education students were considered to be the "primary customers" of a university (8).

We found 68% of the surveyed students either agree or strongly agree that MTBL facilitates long retention of knowledge. In the 1960s, the National Training Laboratories in Bethel, Maine reported the estimated average retention rates of knowledge associated with different learning methods (9). The associations are illustrated in a diagram, which has become known as the learning pyramid. In this pyramid, 90% of knowledge retention was found in teaching others and 50% in discussion groups. Both two learning methods are present in the tRAT component of TBL.

The majority of the surveyed students agreed or strongly agreed that MTBL helps to obtain a higher level of knowledge and it fosters the use of critical reasoning and clinical problem-solving. Boyapati stated that the Royal Melbourne Institute of Technology has a commitment to a student-centered approach to teaching and learning. They think that this approach increases students' ability to communicate effectively, enabling them to identify, formulate and solve problems (10).

The majority of the surveyed students were found either agree or strongly agree that they feel more comfortable when they compare MTBL to other non-lecture active methods. Michaelsen et al. compared TBL to cooperative learning and problem-based learning. They found that the ultimate objective of the group work in TBL, CL, and PBL is essentially the same, that is, motivating students to engage in conversations about the content in ways that improve learning (11).

Obad et al. assessed first-year medical students' perception of teaching and learning through TBL sessions. They made a five-point Likert scale questionnaire to assess three major domains: Reaction, learning, and behavior. Their study indicated that their first-year students perceived TBL positively as a teaching and learning strategy for functional anatomy (12).

**Table 1.** Responses of the Participants to the Questionnaire

|  | Strongly Agree (%) | Agree (%) | Neutral (%) | Disagree (%) | Strongly Disagree (%) |
|--|--------------------|-----------|-------------|--------------|-----------------------|
| MTBL facilitates long retention of knowledge                                       | 31.4               | 36.6      | 16.3        | 9.8          | 2                     |
| MTBL helps to obtain a higher level of knowledge                                   | 37.9               | 32.7      | 18.3        | 8.5          | 1.3                   |
| MTBL effectively Motivates the learning process                                    | 38.6               | 38.6      | 12.4        | 5.9          | 1.3                   |
| MTBL fosters the use of critical reasoning and clinical problem solving            | 31.4               | 38.6      | 21.6        | 2            | 2                     |
| The amount of material is worth the time investment in MTBL                        | 20.3               | 23.5      | 26.8        | 13.7         | 11.8                  |
| I feel more comfortable when comparing MTBL to other non-lecture active methods    | 28.1               | 34        | 17          | 11.1         | 7.2                   |
| I feel more concentrated when comparing MTBL with other non-lecture active methods | 33.3               | 34.6      | 17.6        | 7.2          | 4.6                   |
| Modified TBL increases contribution rate in sessions                               | 35.9               | 37.3      | 16.3        | 5.9          | 1.3                   |
| MTBL makes the instructor more available   | 39.9               | 34        | 14.4        | 7.2          | 2                     |
| MTBL makes the session short   | 24.2               | 33.3      | 23.5        | 12.4         | 3.9                   |
| MTBL should be offered more frequently in the curriculum                           | 37.9               | 30.7      | 17          | 3.9          | 2.6                   |
| I will recommend MTBL to other students  | 43.1               | 32        | 13.7        | 3.9          | 3.9                   |
| I feel totally satisfied with MTBL   | 23.5               | 32.7      | 20.3        | 13.1         | 3.3                   |

Abbreviation: MTBL, modified team-based learning.

**Table 2.** Comparison of the Grades of Batch 26 to the Grades of Batch 27<sup>a</sup>

| Batch           | Grades of Students in Letters |      |      |      |     | Total |
|-----------------|-------------------------------|------|------|------|-----|-------|
|                 | A                             | B+   | B    | C    | F   |       |
| <b>BATCH 27</b> |                               |      |      |      |     |       |
| Count           | 19                            | 87   | 57   | 15   | 4   | 182   |
| % within batch  | 10.4                          | 47.8 | 31.3 | 8.2  | 2.2 | 100.0 |
| <b>BATCH 26</b> |                               |      |      |      |     |       |
| Count           | 4                             | 38   | 45   | 34   | 7   | 128   |
| % within batch  | 3.1                           | 29.7 | 35.2 | 26.6 | 5.5 | 100.0 |
| <b>Total</b>    |                               |      |      |      |     |       |
| Count           | 23                            | 125  | 102  | 49   | 11  | 310   |
| % within batch  | 7.4                           | 40.3 | 32.9 | 15.8 | 3.5 | 100.0 |

<sup>a</sup>Batch 26 studied the course in the form of conventional lectures whereas batch 27 studied the course in the form of modified team-based learning.

Another Saudi study was performed at King Saud bin Abdulaziz University where they studied undergraduate medical students' satisfaction with simulation-based learning. They used a 5-point Likert scale questionnaire that indicated degrees of satisfaction (13).

Hosny et al. applied the MTBL approach to enhance undergraduate medical educational seminars at the Faculty of Medicine, Suez Canal University, and revealed higher tRAT scores compared to iRAT scores. Regarding students' satisfaction, their study showed a statistical significance for all items in favor of the TBL seminars compared to tra-

ditional seminars (14).

The analysis of the exam results of two batches, one of them studied an MTBL orthopedic course, and the other studied the orthopedic course using conventional lecture, revealed a significant difference between their results. Swanson et al. stated that TBL improves students' end-of-course grades, test performance, and classroom engagement (15). Faezi et al. compared the outcomes of TBL versus traditional lectures. The student scores obtained from the short answer questions showed that over time, the student's scores had declined significantly less for the TBL ses-

sions in comparison to the lecture-based sessions. This indicates the ability of TBL to enhance the long-term learning (2).

Although the majority of the students feel satisfied with the MTBL, we cannot neglect the students who exhibit the reverse feeling. Not less than 12% were found either disagree or strongly disagree with all components of the five-option Likert scale questionnaire. Randolph and Posner stated that no best pedagogical approach is available for all courses or classes in management (1). Reigeluth (16) reported a similar result. During an extended period of time, they compared different instructional methods and learning situations in order to answer the question. The lecture was compared with discussion, inductive methods were compared with deductive methods, and the discovery methods were compared with the expository approach.

The final result of these comparisons was as follows: Each of these learning situations or teaching models can be used in a way that makes it better than other alternatives. Because there is no best learning method, it is better to adopt more than one pedagogical approach in the same course.

#### 4.1. Conclusions

MTBL, in which students are taught in small separate groups with different instructors, improves students' performance in their final exam. The students feel more satisfied with MTBL. Because there is no best learning method MTBL should be used with other learning methods.

#### Footnotes

**Authors' Contribution:** Khalid Husein participated in the analysis of the data and wrote the methodology, results, discussion, and conclusion. Elsiddig Mahmoud participated in writing the literature review. Both authors participated in data collection.

**Conflict of Interests:** The authors declared that they have no competing interests.

**Data Reproducibility:** The datasets presented in the study are available at the request of the corresponding author during the submission or after the publication.

**Ethical Approval:** Ethical clearance was obtained from the Ethical Review Committee of the Faculty of Medicine and Health Sciences, Omdurman Islamic University (SD.OIU.REC.0464.213).

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**Informed Consent:** Informed consent was taken from each student participating in the study.

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