

Comparison of Team-Based Learning and Lecturing Methods in Pharmacological Biotechnology for Pharmacology Students

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Abstract

Background: Active learning methods are strategies used by most universities worldwide to enhance the problem-solving ability and develop critical thinking in students. Team-based learning (TBL) is one of these methods, in which students study the lesson prior to discussion. At the beginning of the session, the individual readiness assurance test (iRAT) is given to students, and then they answer the same questions through discussion in a team. Finally, problems are resolved by the teacher and results are given to students.

Methods: In the current study, 30 pharmacology students were randomly assigned to two groups of 16 and 14 subjects. The educational content of pharmaceutical biotechnology was given to the 16- and 14-subject groups using traditional lecturing and TBL methods, respectively. Finally, both groups were assessed and compared based on a same method.

Results: The average scores of the lecturing and TBL groups were 6.77 ± 1.97 and 8.32 ± 2.65 out of 13.75, respectively (6.25 scores belonged to class activities, which were not included in comparisons). No significant difference was observed between the mean score of groups ($P = 0.07$), although the difference was very close to significant, which can be attributed to the current study's small sample size. One subject in the TBL group and six in the lecturing group failed to pass the course; the difference between the groups in this regard was noticeable.

Conclusions: Although results of the current study showed no significant superiority of TBL over the lecturing method, most students were satisfied with the TBL method. Hence, it is recommended to employ this method with freshmen.

Keywords: Team-based Learning, Pharmacology, Readiness Assurance Test, Pharmaceutical Biotechnology

1. Background

Since most traditional teaching methods are unidirectional, universities worldwide tend to use student-centered teaching practices. Such methods emphasize development of critical thinking as well as enhancement of the ability to solve problems in students. In addition, such methods challenge students and are naturally active; hence, learning through student-centered teaching practices has long-lasting outcomes (1).

Team-based learning (TBL) is a student-centered teaching method developed by Michaelsen et al. (1997); they originally applied this method to the crowded classes of trading management, but soon TBL was used in medical education following some changes (2, 3). TBL is an active learning method that needs team cooperation. The superiority of TBL over similar methods that rely on small groups, such as problem-based learning, is its less dependence on lecturers (3).

TBL relies on four major principles: forming and maintaining the groups, making students responsible for individual and group tasks, giving timely feedback, and design-

ing teamwork approaches to promote learning and develop teamwork. Similar studies suggested the formation of heterogeneous groups of three to seven subjects. The educational contents of the next session are given to the students, and at the beginning of each session, students are assessed using the individual readiness assurance test (iRAT). Then, the same questions asked in iRAT are discussed in teams, and students are assessed through the team readiness assurance test (tRAT). Finally, the lecturer provides a summary of both tests' results. This stage can resolve students' problems and misunderstandings. The next stage involves application of the learned items and group discussions (4, 5).

The TBL method is mostly used by medical schools, compared with other health care education institutes; medical schools use this method in the education of physiology, anatomy, pathology, neurology, and pharmacology (6). Letassy et al. were among the first researchers who employed TBL in pharmacology education to teach the endocrine module (7). Then, it was employed in other courses such as the cardiovascular module, medication, pharma-

cokinetics, and global health (8-11).

So far, TBL has been employed in the education of anatomy for medical students; internal diseases, surgery, and nutritional science for nursing students; maternal and neonatal health internships for midwifery students; and neurology for rehabilitation students (12-16).

As there is a lack of studies on TBL in Iran, based on the abovementioned findings and reports about the superiority of TBL over the lecturing method in pharmacology education (5, 6) the current study aims to compare the TBL and traditional lecturing methods in pharmaceutical biotechnology for pharmacology students at the Kerman University of Medical Sciences, Kerman, Iran.

2. Methods

A total of 30 pharmacology students who took the pharmaceutical biotechnology course in the spring semester of the academic year 2014 - 15 were enrolled in the study. The subjects were assigned to two groups based on their grade point average. The first group (n = 16) was trained using the traditional lecturing method and the second group (n = 14) using the TBL method. One-thirds of the final score was allocated to class activities, and the remained two-thirds to the final exam score. Before intervention, the participants signed a written informed consent. Students were assigned to groups based on their place of residence; most subjects lived in private houses with their families or in rented houses by themselves or with one or two friends. The residual status was observed through communication between the groups in a dormitory, which could influence the results of the study.

The first group was trained using the traditional lecturing method along with PowerPoint presentations and educational videos for particular issues. The class activity of the first group was limited to a quiz and oral questioning, as well as a research project on class discussions that was carried out in a team.

Subjects in the TBL group were assigned to three teams of four to five subjects, regardless of gender; hence, the teams were heterogeneous. Since the subjects had no teamwork experience, they were trained in the principles of TBL in the first session. The educational content of the subsequent session was given to the subjects in each session. At the beginning of a session, the iRAT and tRAT were conducted; for this purpose, 8 - 10 multiple-choice questions were given to each student, and then the same questions were posed to the teams to answer through teamwork. The answers were analyzed, and students' weaknesses and problems were resolved. Finally, based on the topic of the lesson, the teams were made to focus on problem solving or case discussion. The class activity of the sec-

ond group comprised iRAT, tRAT, and active engagement in teamwork and group discussions.

A final exam was held for both groups at the same time in the same place with the same questions. The raw scores of the students in both groups (final exam score) were analyzed using descriptive statistics (central and dispersion indices) and a paired t test using SPSS version 20 (SPSS Inc., Chicago, IL).

Forty days later, the same exam was conducted without prior notice, and the average score of students in the first and second exams were compared. Only seven subjects in the first and 10 subjects in the second groups participated in the second exam. To fill the gap, the scores of students who missed the exam were predicted mathematically with SPSS.

Then, students in the second group were asked to comment on the TBL method through three open questions.

3. Results

Learning based on TBL was difficult for the students at first, but they showed remarkable advancement in session 4, which gradually enhanced their understanding.

The average scores of the first (traditional lecturing method) and second (the TBL method) groups were 6.77 ± 1.97 and 8.32 ± 2.65 of 13.75, respectively. It is noteworthy that 6.25 scores were allocated to class activities, which was not included in comparisons. Comparisons showed no significant differences between the groups ($P = 0.07$); however, the difference was very close to the level of significance, which can be attributed to the inadequacy of data.

The exam failure rate was 6 in the first group and 1 in the second.

The average scores of the second exam (held 40 days after the first exam) for the first and second groups were 4.15 ± 1.38 and 5.18 ± 2.34 , respectively. The minimum and maximum scores of both groups are shown in Table 1. According to the results, there was no significant difference between the groups, but the difference between the average scores of the first and second exams was significant in both groups. The level of learning loss (comparison of the average scores of the first and second exams) was 19% in the first and 22.6% in the second group.

There was a significant difference between the average scores of the second exam (4.36 ± 1.92) and the first exam (7.49 ± 2.41) in both groups.

The students' comments on TBL are shown in Table 2.

4. Discussion

In the current study, the students actively participated in group discussions, and if there was bias between their

Table 1. Data on the Study Groups for the First and Second Exams

Group	Exam	Number	Minimum Score	Maximum Score	Mean \pm Standard Deviation
1 (Traditional lecturing)	First (day 0)	16	3.50	10.50	6.77 \pm 2.97
	Second (day 40)	16	1.0	6.75	4.15 \pm 1.38
2 (TBL)	First (day 0)	14	3.25	11.75	8.32 \pm 2.65
	Second (day 40)	14	1.0	10.00	5.18 \pm 2.34

Abbreviation: TBL, team-based learning.

Table 2. Comments of the Study Participants on the Team-based Learning Method

Questions on Comparing the Methods	Analysis of the Answers
Strengths of the lecturing method	No strengths observed
Strengths of the TBL method	Learning for a long term Improved creative and critical thinking skills in students More interaction and cooperation in the group
Weaknesses of the lecturing method	Boring and unidirectional learning More anxiety for students due to the risk of getting a lower score
Weaknesses of the TBL method	Time-consuming for both students and the lecturer Novelty of the method for students
Effect of the TBL method on deep learning	High

Abbreviation: TBL, team-based learning.

opinions and the correct answers, they tried to explain their ideas using available references. As expected and according to the results of similar studies (3), students' scores were higher in tRAT, compared with those in iRAT (3). This indicated that students played a significant role in training and teaching their classmates. Although results of the current study showed no evidence on the superiority of the TBL method over the traditional lecturing method, which can be attributed to the small sample size, the students were highly satisfied with the TBL method.

According to similar studies, results of the paper exams were similar in both groups trained with the TBL and traditional lecturing methods (3), although other researches showed better results, i.e. more efficacy of TBL on educational achievement of students (1). In a study by Nieder et al., which used the TBL method in an anatomy course for medical students, no significant difference was observed between the scores of the students and their former classmates who were trained using another method;

however, the level of satisfaction with the TBL method was high among both students and lecturers. Even lecturers preferred this method in small groups and positively evaluated the results of the TBL method (3). According to a study by Ofstad and Brunner, despite there being no significant difference between the scores of students trained by the TBL method and those trained using nonteam-based learning, the failure rate was lower in the TBL group (6), which is in agreement with the findings of the current study.

Results of a study by Letssay et al. showed that the scores of pharmacy students who passed the endocrine module course taught using the TBL method were higher than those trained by the traditional lecturing method (7). Conway et al. also reported the satisfaction of lecturers and students with the TBL method and indicated that the method had no negative impacts on the performance of students.

Vaezi et al. (12) and Hassanzadeh et al. (13) indicated that the TBL method was useful in communicating the concepts and helping students understand them as well as in facilitating and deepening the learning in students. In the current study, although no significant differences were observed between the scores of students trained by the TBL method and the traditional lecturing method, the rate of students' satisfaction with the TBL method was higher than that of the lecturing method. Although students reported higher anxiety with the TBL method and required more time, the bidirectional nature of TBL and the active cooperation of students in class affected their acceptance of the method.

One limitation of the current study was its small sample size, which decreased further in the second exam (the exam held 40 days after the first exam). The novelty of the TBL method for the students was another limitation. Perhaps employment of the current study population in further studies may lead to more reliable results, as the teams have already been formed and students have learned the teamwork.

It is time-consuming for the lecturer to prepare a session based on the TBL method, which is one pitfall of the

method (5). It is also quite time-consuming to design tests and exercises based on the iRAT method to educate students practically, because according to this method, the questions should be designed in a way that involves students in the issue and does not deal with only their knowledge. This is one reason why some lecturers reject the iRAT. Nevertheless, different studies in this regard recommended the employment of this method for teaching purposes.

4.1. Conclusion

It is recommended to employ the iRAT method from the first year of study at a university. Even if no significant difference is observed between the results of this method and those of traditional teaching methods, the iRAT method is preferred for medical students because it allows for more participation of students in the teaching process and more interaction between students and lecturers.

Supplementary Material

Supplementary material(s) is available [here](#) [To read supplementary materials, please refer to the journal website and open PDF/HTML].

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