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Comparing the Impact of TBL Versus Lecture Method on Pharmacy Students' Academic Self-efficacy in a Pharmaceutical Biotechnology Course: A Quasi-Experimental Study

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Abstract

Background: Students with higher academic self-efficacy usually show higher levels of academic adaptation and are agile in using variant learning strategies. In this regard, training-based learning (TBL), a relatively new educational method, can be considered a complementary method in the education of pharmacy students.
This research aims to compare the effect of TBL with the lecture method on the academic self-efficacy of pharmacy students in pharmaceutical biotechnology courses.

Methods: This was a quasi-experimental study of pretest and posttest types with random assignment to 2 control and experimental groups, in which the effects of team-based training and lecture methods were studied in the pharmaceutical biotechnology course. In the experimental group, the students were divided into 8 groups of 6 people, and they spent 5 sessions of the pharmaceutical biotechnology course with the TBL method, and the control group also received the same content by the lecture method. Both groups answered the self-efficacy tool before the intervention, and at the end of the intervention, both groups answered the tool again. After the approval of the university ethics committee and obtaining informed consent, the self-efficacy questionnaire was distributed in person and online among the participants. The quantitative data were collected and analyzed using SPSS software Version 19 (mean and standard deviation, homogeneity of the 2 groups, tests, and Kolmogorov-Smirnov).

Results: The data analysis showed that most of the participants were 22 years old. The independent samples t test results showed that the 2 groups did not have a statistically significant difference in the mean age ($P = 0.058$). Also, there was no statistically significant difference between the 2 groups in the pretest ($P = 0.391$), and the 2 groups had almost the same mean. Still, there was a statistically significant difference between the 2 groups in the academic self-efficacy variable in the posttest ($P < 0.001$).

Conclusion: Team-based teaching methods can increase students' participation and enthusiasm in learning and applying self-efficacy and self-management skills, introducing more diverse career and educational opportunities for pharmacy students.

Keywords: Team-based Learning, Academic Self-efficacy, Teaching Method, Pharmacy

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↑What is "already known" in this topic:
Students learn course material better by being active in the team-based learning teaching method. Implementing the team method compared to the lecture method has a favorable effect on increasing the learners' learning and understanding.

→What this article adds:
It seems that new educational methods, such as team-based learning, can effectively improve students' academic levels. Teaching methods based on team learning can increase students' participation and enthusiasm in learning and applying self-efficacy and self-management skills and, as a result, introduce more diverse career and educational opportunities for pharmacy students.

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Introduction

Self-efficacy is perceived as the individuals' ability to conduct their affairs to attain favorable results (1). In other words, self-efficacy addresses one's beliefs regarding one's ability to equip oneself with cognitive and motivational resources and willingness to take control of a specific situation/event (2). Bandura et al noted that perceived self-efficacy, on the one hand, affects an individual's ability to adapt and their flexibility to face difficult situations, and on the other hand, their enthusiasm, analytical thinking, and perseverance in experiencing failure. Self-efficacy beliefs are perceived as a person's confidence in their ability to deal with and manage complex situations such as academic stressors, future goals, choice of behaviors, and prevailing motivational patterns (3). Zimmerman points out that self-efficacy is a multidimensional concept. Therefore, the size of the self-efficacy effect is different according to the scope of demands. Based on this premise, some researchers emphasize that the evaluation of the self-efficacy structure should be done depending on the context of the results. Therefore, in academic situations, it seems more appropriate to evaluate academic self-efficacy compared with general self-efficacy (4, 5). In this regard, studies have confirmed the higher value of evaluating academic self-efficacy compared with general self-efficacy in predicting the pattern of students' effort and progress (6). Bandura emphasizes that self-efficacy positively affects the student's academic outcomes by increasing their motivation and persistence to master challenging academic assignments, as well as by facilitating the efficient use of knowledge and skills learned.

As one of the active learning methods, training-based learning (TBL) is a suitable educational strategy for small groups that provides an opportunity for students to acquire conceptual knowledge through a series of activities that include individual work, group work, and immediate Feedback (7). In fact, The self-directed learning methods used in TBL put the student in the decision-making position instead of the professor, which is effective in the future professional skills of the students (8). TBL has provided an opportunity to teach in an engaging manner in which many students participate and receive immediate feedback while enabling active discussions in small class groups (9). TBL, in an approach beyond the simple conveying of content, deals with using knowledge through conceptual problem-solving. In recent years, this method has gained popularity in medical education as a student-centered and efficient method, which is sometimes introduced as an alternative to problem-based learning (PBL). TBL not only has the advantages of PBL but also, unlike PBL, it requires fewer teachers (10-14, 15). This may be the reason for the growing trend of TBL applications in medical science education centers at a global level in recent years (10). Due to the great diversity in TBL methodology in medical education, Haidt et al (2012) developed a standard framework for its application in medical education (11). TBL offers an innovative approach to student-centered learning based on the flipped classroom method (7). TBL provides an interactive training session under the instructor's supervision, which allows many students to work in small teams to apply scientific content to solve a specific problem (8). The structured format of TBL provides an opportunity to build and apply conceptual knowledge through a series of activities, including preparation and testing to ensure readiness, feedback, and strengthening problem-solving ability. The main goal of learning in TBL goes beyond simply covering the content. The main goal is to focus on ensuring that students have the opportunity to practice applying the concepts of the course to solve problems. The results from several studies have proven the benefits of TBL (8) (12, 13). Systematic reviews have also confirmed the effectiveness of TBL compared with conventional methods (10-14, 15). The interactive nature of TBL encourages students to expand their communication and collaboration skills and provides a valuable learning experience (11). In addition, since the course materials are provided to the students before the session, and they are required to study before the class, using the flipped classroom method, more time in the class is devoted to problem-solving and critical thinking, which leads to greater understanding.

The TBL method consists of 4 main components as follows:

Carefully forming and managing teams: Students should be assigned to teams using a transparent process to ensure that teams based on preexisting friendship groups do not exist and that each team has a diverse mix of students (such as background knowledge and gender composition) (13).

Frequent and timely feedback: Providing immediate feedback is an integral part of the TBL process and ensures that students know their level of content knowledge. Facilitators identify students' content knowledge gaps and challenge them through follow-up questions (rather than lectures), fostering critical thinking. In fact, providing feedback is the key to acquiring knowledge, maintaining, and developing the team (16).

Problem-solving: Participation in problem-solving activities encourages learning through the use of challenging questions. Haidt et al (2012) recommend that the "four S's" of problem-solving in TBL should always be applied: significant problem, same problem, specific choice, and simultaneous reporting (7).

Student peer assessment: Peer assessment motivates students to participate in problem solving and group learning actively and helps ensure student accountability. In addition, giving and receiving constructive feedback is an essential professional skill for health professionals (13).

Overall, it seems that TBL, as a teaching method, enables a large group of students to participate in group-based learning experiences with a relatively lower number of teachers in a flipped classroom format. Learning in small groups of students, receiving immediate feedback, and peer evaluation are among the most important aspects of TBL. Of course, it should be remembered that using a standard framework in implementing and facilitating TBL is essential for obtaining better and deeper learning results. In the present study, the researchers aim to compare the effect of TBL with the lecture method on the academic self-efficacy of pharmacy students in pharmaceutical bio-

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technology courses: a quasi-experimental study of Kermanshah University of Medical Sciences in pharmaceutical biotechnology course.

Methods

This was a quasi-experimental study of pretest and posttest types with random assignment to 2 control and experimental groups, in which the effect of team-based training and lecture method was studied in the pharmaceutical biotechnology course. This study was conducted on 87 Kermanshah University of Medical Sciences pharmacy students. The method of determining the total sample was enumeration. Participating students were divided into 2 groups based on the TBL (17) and lecture groups (18) using the random allocation method based on Excel software. The sample size was calculated using Formula 1 with a 95% CI and a statistical power of 0.80. This formula used the mean and standard deviation parameters from the study conducted by Heidari et al in 2023 (19) (a = 0.05 and β = 0.10, power = 90/0, d = 1.2, and σ = 1.4)

Formula 1:

$$n = \frac{2\sigma^2(z_\beta + z_\alpha)^2}{d^2}$$

N= 2(1.96+1.29)2 1.4 2 = 29

Due to the risk of dropouts, we raised the number of participants in both groups (lecture/10 & TBL/19) in this study in order to promote educational justice and boost the study's dependability (Diagram 1).

The TBL group was assigned a larger number due to the work group performance and groups of 6.

In the experimental group, the students were divided into 8 groups of 6 students. They spent 5 sessions of the pharmaceutical biotechnology course using the TBL method, and the control group did not receive the same content through the lecture method. Both groups answered the self-efficacy tool before the intervention, and at the end of the intervention, both groups answered the tool again.

The researchers took measures to increase the internal and external validity of the research, including random allocation of samples, compliance with study protocols, and strictness in managing variables, reducing the effect of disturbing and unwanted variables to a minimum.

At this stage, each group had to reach a consensus among the members present in that group to choose the answers to all the questions. The simultaneous reporting principle by Dr. Michelsen was considered to obtain the greatest learning effect. Simultaneous reporting is 1 of the 4 principles proposed in TBL (significant problem, same problem, specific choice, and simultaneous reporting): the choices should be made simultaneously by members and groups should be gathered and not allowed to change their opinions based on the solution of other groups (20, 21). After all group members finished answering the self-efficacy tool, each group member presented their answers to the questions for their group at the same time. They discussed the answers with other groups and justified their answers. After presenting their answer, each group explained why they chose a particular option for the neighboring groups. The feedback on the group examination was given immediately in the class, and the teacher, as a facilitator, discussed all the students' questions and answers and clarified any concept that the students had difficulty understanding. All participants answered Bandura's academic self-efficacy questionnaire online before the experiment. The questionnaire made by Bandura to measure the self-efficacy of supposed self-efficacy consists of

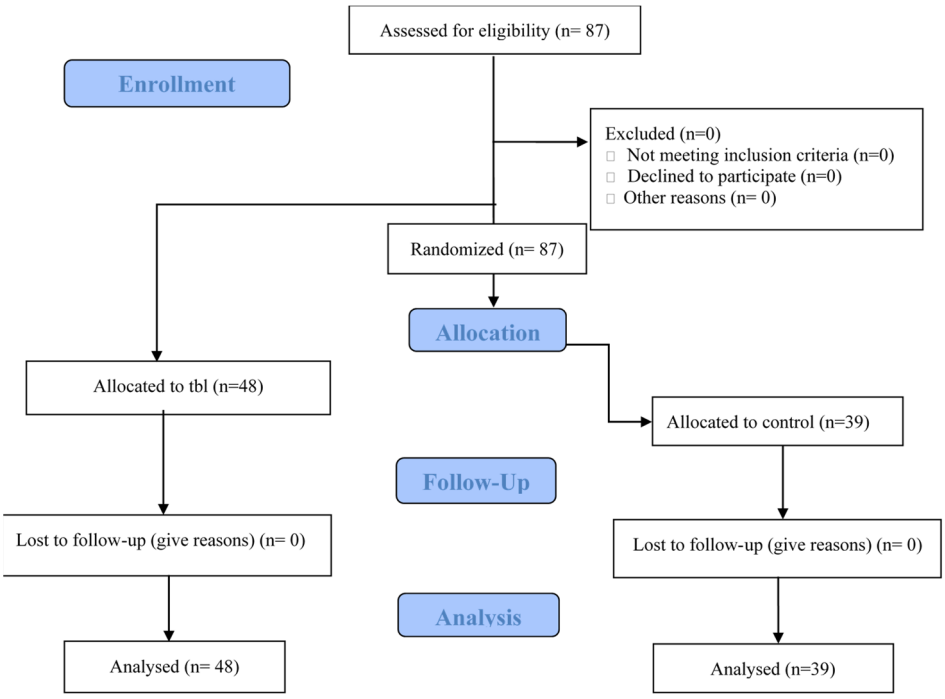

Diagram 1. The stages of research sampling

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55 items that measure self-efficacy in 6 areas. After calculating each member's scores in each region, the overall self-efficacy scores of the students are obtained by adding up the scores of the 6 fields. Cronbach's alpha coefficient of Bandura's self-efficacy questionnaire is reported as 0.92 by Mortazavi (2013) from the total Iranian data, and it is also 0.92 in the research reported by Khaksar, 2004 (quoted by Samadi, 2006). In this study, the Cronbach's alpha value of this questionnaire was calculated as 0.81, and 5 medical education professors confirmed the reliability and face validity of the tool. After the approval of the university ethics committee and obtaining informed consent, the self-efficacy questionnaire was distributed online among the students, and quantitative data were collected and analyzed.

Data Analysis

SPSS software was used for data analysis. Descriptive statistics such as means and standard deviations were used to describe the participants based on quantitative demographic variables and their scores from the nominal and ordinal scales before and after the intervention. Inferential statistics were also used to compare the homogeneity of the 2 groups based on demographic variables and compare the participants with each other after the intervention. The 2 intervention and control groups were homogeneous and similar in demographic characteristics ($P > 0.05$).

Results

The data in the Table 1 the gender variable of the research sample, which showing that 58% of the students in the TBL group were men and 42% were women. Also, in the lecture group, 56% were men and 44% were women. There were 39 students in the lecture group and 48 in the training group with TBL.

The data in the Table 2 demonstrate the age variable of the research sample, showing that most of the students were 22 years old. The independent t test results showed that the 2 groups did not have a statistically significant difference in their mean age.

According to the significance level of the research variables ($P = 0.424$), the data of all the variables were normal, and parametric tests can be used to test each of the variables. Based on the results obtained from Levine's test, the obtained P value ($P = 0.424$) was greater than the critical value ($\alpha = 0.05$); thus, the prediction of the assumption of homogeneity of variance was confirmed.

The data in the Table 3 show no statistically significant difference between the 2 groups in the pretest, and the 2 groups have almost the same mean. The mean of the experimental group was equal to 2.62, and that of the control group was 2.49.

The data in the Table 4 show the mean and standard deviation of the academic self-efficacy dimensions of the groups in the pretest. As the P value shows, there is no statistically significant difference in self-efficacy between the groups in the pretest. However, the P value shows a significant difference in self-efficacy between the 2 groups in the posttest.

Table 1. Gender Distribution in the sample (87 Students)

	TBL group	Lecture Group
Gender	Statistical frequency, %	
Female	20 (0.42)	17 (0.44)
Male	28 (0.58)	22 (0.56)
Total	48 (0.55)	39 (0.45)

Table 2. Compare the Mean and Standard Deviation of Age in the Students

	TBL Group	Lecture Group
	M ±SD	M ±SD
Age	21.89±4.62	22.14±3.81
P value	0.058	

Table 3. Comparison of the Mean Score of Academic Self-efficacy of Students Before and After the Intervention

	Step	Mean	Standard Deviation	Mean Difference	T	*P* value
TBL group	Before	2.62	1.71	2.06	1.95	<0.001
	After	4.68	1.77			
Lecture group	Before	2.49	1.56	0.05	1.72	0.388
	After	2.54	1.39			

Discussion

The results of this study showed no statistically significant difference between the 2 groups in the pretest, and the 2 groups had almost the same mean. Still, there was a significant statistical difference between the 2 groups in the academic self-efficacy variable in the posttest. Application of teaching methods based on team learning can increase students' participation and enthusiasm in learning and applying self-efficacy and self-management skills and, as a result, introduce more diverse career and educational opportunities for pharmacy students. Professor Michaelson first implemented this method in 1990 at the University of Oklahoma. Due to the increased number of students, he decided to plan and execute a training strategy that could make the most of class time, be effective, and prepare students to face future issues (23). In a study

Table 4. Comparison of Academic Self-efficacy Dimensions in 2 Groups in the Pretest and Posttest

	TBL Group	Lecture Group	TBL Group	Lecture Group
Dimension	Pre-test	Pre-test	Post-test	Post-test
	M±SD	M±SD	M±SD	M±SD
Educational accomplishment	27±4.92	28±5.12	40±2.25	28±5.36
Self-regulation of learning	33±5.08	34±4.80	51±1.27	35±2.68
Extracurricular activities	22±3.52	24±4.37	33±4.15	23±5.17
Exceeding the expectations of others	9±2.32	8±2.55	17±1.26	9±2.11
Motivational self-regulation	13±2.53	14±2.87	26±3.09	14±2.54
Own strength	10±3.61	11±2.85	17±1.83	10±2.34
P value	0.521	<0.001		

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conducted on the learning satisfaction levels of second-year medical students with the implementation of TBL, the results indicated that the students' teamwork had improved, and the students' feedback was positive (24). A study titled The Effect of Team-based Learning in an Educational Campus Program on Learners' Self-efficacy and Teacher Professionalism was conducted by Suwartono et al in Indonesia. The results showed that the learners who participated in the educational campus program were superior in terms of self-efficacy compared with those who did not. In addition, teachers who have cooperated with students in their schools have stated that they have benefited from this plan (25). During a systematic review of all the articles published between 1998 and 2013 about comparing academic progress in students in 2 methods of lecture and problem-based learning, it was concluded that the use of problem-based learning methods increases the cognitive ability of medical students. Since the lecture method is used as the most common teacher-centered teaching method in theoretical courses, and considering the limitations of this method, such as student inactivity and learner fatigue, it is necessary to promote student-centered methods to increase the quality of teaching (26). A study by Yousefi et al showed a positive and significant relationship between academic motivation and self-directed learning, and based on these results, medical education planners can provide means for improving the quality of medical education as a step forward for a more efficient medical education (27). The results of the study conducted by Nouhi et al showed that the problem-solving learning method is associated with group participation in learning, active learning, learner independence, and the development of learner's critical thinking (28). The results of the study conducted by Molashahi et al showed a significant difference between the mean knowledge scores of students, the lecture group, and the TBL group in favor of TBL. Also, a significant difference was observed between the mean scores in the individual assessment in the TBL group and the group assessment. Also, the results showed a significant difference between the mean attitude scores of students in the lecture group and the TBL group in favor of TBL. These findings indicated the effectiveness of the team-based learning method in raising the knowledge and attitude of midwifery students (29). The results of the study by Jafari et al showed a significant difference between lecture-based and team-based learning in students' final grades, and the results indicate that students are more successful and satisfied with team-based learning compared with traditional lectures in neurology education (30). In the systematic review conducted by Burgess et al, it was shown that although there was considerable variation in terms of study design and depth of description among the reviewed studies, TBL was shown to provide a positive learning experience for students (31). In the study conducted by Silberman et al on pharmacy students, it was shown that TBL improves critical thinking skills in these students. However, the authors believe more research is needed to identify specific aspects of TBL that influence critical thinking (32). In a study conducted by Sharifdini et al on 35 third-year Pharm.D students at Gilan University of Medical Sciences Faculty of Pharmacy using TBL, it was shown that after the end of teaching the 2 topics of tissue engineering and microfluidic systems in pharmaceutics 5 courses, there was a significant difference between pretest and posttest scores for both groups of students. However, even though the mean posttest scores of students in the Gallery Walk teaching method were higher than the traditional method, this difference was not statistically significant (33-36).

Conclusion

The results of this study showed no statistically significant difference between the 2 groups in the pretest, and the 2 groups almost had the same mean. Still, there was a significant statistical difference between the 2 groups in the academic self-efficacy variable in the posttest. This study's results showed a significant statistical difference in the academic self-efficacy of pharmacy students in pharmaceutical biotechnology subjects. It seems that new educational methods, such as team-based learning, can be effectively used to improve students' academic levels. It seems that students in TBL better absorb course material due to active participation.

Due to their increased reliance on memory, learners using the lecture method have occasionally forgotten the content, but those using the other approach have been able to achieve higher academic self-efficacy scores on the knowledge assessment examination.

This result confirms that implementing the TBL method compared with the lecture method has a tremendous effect on increasing the quality and depth of the learners' learning and understanding. The TBL method causes deep learning, increases self-efficacy skills and student participation, and facilitates learning. It is suggested that the team-based learning method be used more in the education of learners and students of various fields of medical sciences.

Authors' Contributions

This manuscript is the result of the collaboration of all the authors. M.R. & Gh.R. designed the study, wrote the proposal, and conducted data collection and analysis. M.SH. & A.H. analyzed the data, and A.B., M.GH., and S.H. wrote the final draft of the manuscript, prepared tables, and submitted the document to the journal. All authors read and approved the final manuscript.

Ethical Considerations

The present study has been conducted as a research project at Kermanshah University of Medical Sciences with identification code 50001632 and approved by the university ethics committee (IR.KUMS.REC.1401.456).

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Conflict of Interests

The authors declare that they have no competing interests.

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