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Comparison of Problem-Based Learning and Lecture Methods on Teaching and Learning Satisfaction: A Quasi-Experimental Study

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A B S T R A C T

Introduction: Students' cognitive capacities are enhanced through the implementation of innovative pedagogical practices, which motivate them to apply their reasoning abilities to solve issues more efficiently and with better quality. Therefore, the current study was conducted to compare problem-solving learning (PBL) and lecture methods on the level of satisfaction with teaching and learning.

Materials & Methods: This was a quasi-experimental research study conducted at Ilam University of Medical Sciences in 2022, involving a sample of forty emergency medical associate students selected through a convenience sampling approach and randomly allocated to control and intervention groups by dice throw. The tools included questionnaires on demographic information, satisfaction with teaching, and learning rate, which were completed before and two weeks after the end of the intervention. Descriptive and analytical tests were performed using SPSS V.16, with alpha set at 0.05.

Results: The mean and standard deviation of the participants' age was 20.09±1.14. Before the intervention, there was no significant difference in learning satisfaction and learning rate between the two groups. However, after the intervention, there was a significant difference in learning satisfaction and learning rate between the two groups (P=0.003 and P=0.001).

Conclusion: Teaching using problem-solving methods increased satisfaction with teaching and improved the learning rate of students.

Keywords: Problem-Based Learning, Lecture, Satisfaction, Teaching

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Introduction

The methods and approaches to education worldwide have been undergoing transformation for some time. Students tend to engage with diverse and enjoyable topics and questions in varied educational environments. However, traditional methods still prevail in some classrooms (1). At the university level, educational programs generally follow two models: professor-oriented and student-oriented.

In the teacher-centered model, the instructor attempts to convey a large amount of information in a short period through oral lectures, and learners try to memorize the presented information. In this method, students are not encouraged to think critically or analyze the material, leading to most of the information being quickly forgotten (2). Another problem with this method is the lack of necessary time for students' intellectual exchange and examination of the topic (2). Consequently, students become passive participants in the classroom.

Research conducted in Iran shows that more than half of the clinical instructors use passive teaching methods, such as lectures (3), while most students in hospitals prefer and need to use active learning methods. They show a strong preference for modern education over traditional and passive methods (4).

On the other hand, the collaborative or student-centered model addresses comprehensive needs and abilities. In this model, students have a more active role and are responsible for their learning, allowing instructors to implement new learning methods.

At the same time, learners have ample opportunities to share their experiences and opinions with others. The use of modern teaching methods strengthens learners' mental abilities, enabling them to apply their thinking and rational powers toward reasoning and problem-solving (4). These methods are effective in improving thinking skills and encouraging learners to actively participate in the learning process (5). Therefore, in university classrooms, the teaching approaches of faculty members play a crucial role in encouraging students to adopt the most effective learning methods (6).

Although no single educational method has absolute superiority over others, active learning methods such as Problem-Based Learning (PBL), which involve greater learner participation, can achieve desired educational goals. These methods are preferred over passive methods because they utilize advanced teaching strategies, allowing learners to acquire knowledge more quickly and efficiently (7).

Problem-Based Learning (PBL) is an educational approach that facilitates inclusive learning through questioning and scenario-solving. Learners, divided into groups, are compelled to find the information necessary to solve a problem. During these new learning processes, learners actively engage in specific learning activities, thereby strengthening and consolidating their deep learning abilities (8). Lukitasari et al.'s study showed that hybrid PBL effectively teaches students to improve their critical thinking skills in responding to given tests (9). Additionally, these methods enable learners to be actively involved in the learning process, understand the learning outcomes, and achieve this in less time and at a lower cost (10). Employing a variety of methods places learners in dynamic environments, increasing their motivation and improving their satisfaction with teaching (11).

Satisfaction with teaching refers to the difference in providing education to learners based on available facilities, educational needs, and the challenges addressed by the type of education (12).

Due to the passage of time and the rapid expansion of scientific and research fields in human resources, there is an urgent need for training, retraining, and revising previous learning by educational institutions (13). Training in disaster control and crisis management is an essential component of nursing and emergency medical courses (14). Since pre-hospital care is the first component of the healthcare system, its correct and optimal performance can reduce problems caused by long-term disabilities and mortality resulting from crises (15). Although disaster courses in the associate field of emergency medicine are designed to be clinical and functional in dealing with crises, they are often taught by professors using traditional lecture methods.

Therefore, the current study was conducted to compare the Problem-Based Learning (PBL) and lecture methods on the level of satisfaction with teaching and learning in emergency medicine associate students.

Materials and Methods

Study design

This study was a quasi-experimental research conducted from August 30th to December 25th, 2022, at the School of Nursing and Midwifery of Ilam, Iran.

Setting and Sample

Participants were selected using convenience sampling, considering inclusion criteria such as willingness to participate in the study, scoring less than 10 on the entrance exam, and no prior failures in the disaster emergency course. Exclusion criteria included excessive

absenteeism, withdrawal from studies, and incomplete questionnaire responses. Forty students who had chosen the disaster course during one academic year were randomly assigned to either the intervention or control group. Randomization was achieved using the dice-throwing method. The first person on the class list to throw the dice determined membership in either group. Ethical considerations included obtaining ethics approval (IR.MEDILAM.REC.1401.104), maintaining integrity in data collection and reporting, securing written informed consent from participants following the Declaration of Helsinki guidelines, and adhering to human research protocols.

Sample Size, Randomization and Blinding

Given the quasi-experimental design and convenience sampling, forty participants were randomly allocated to the control group (twenty participants) and the intervention group (twenty participants) using dice throwing. The first person in alphabetical order on the class list threw the dice. Participants were assigned to the intervention group if they threw an odd number and to the control group if they threw an even number. The initial dice thrower was assigned to the intervention group as they threw an odd number. Subsequent participants were assigned using the same method, ensuring no manipulation in allocation. The final participant list was then generated, and the research team had no further access to alter allocation. Additionally, participants in the intervention group received interventions on Saturdays and Mondays, while those in the control group received interventions on Sundays and Tuesdays, ensuring blinding throughout the study period.

Measuring Tools, Validity and Reliability

1. Demographic instrument

The demographic variables assessed included age, marital status, total average, rejected units, and occupation.

2. Lin Teaching Satisfaction Questionnaire (LTSQ)

The LTSQ comprises 18 items rated on a 5-point Likert scale, ranging from "completely agree" to "completely disagree," with scores ranging from 18 to 90. Higher scores indicate higher satisfaction with teaching. The English version of the questionnaire has demonstrated acceptable validity, and its reliability was found to be 0.873 using Cronbach's alpha (16). The Persian version has also been validated in Iran, with reported validity and reliability coefficients of 0.736 using the internal consistency method (Cronbach's alpha).

3. Learning Rate Questionnaires (LRQ)

The LRQ was developed by the study team to assess learning outcomes. It consists of two series, each containing twenty questions with multiple-choice options. The first series is identical across iterations, while the second series comprises twenty distinct questions compared to the first iteration. The difference in scores between these two exams reflects the learning score, where correct answers are scored as one point and incorrect or unanswered questions receive zero points. Scores range from 0 to 20, with higher scores indicating greater learning proficiency.

For validation using the Baltz and Wessel technique, a sample of 10 faculty members was utilized to assess Content Validity Index (CVI) and Content Validity Ratio (CVR). The first series demonstrated CVR of 0.802, CVI of 0.788, and internal consistency (Cronbach's alpha) of 0.921. The second series showed CVR of 0.864, CVI of 0.876, and internal consistency (Cronbach's alpha) of 0.961. These metrics indicate robust validity and reliability of the LRQ for evaluating learning outcomes in the study context.

Intervention

Following the acquisition of ethical approval, implementation of random allocation, and establishment of inclusion and exclusion criteria, participants completed the demographic instrument, LTSQ, and LRQ through an online platform.

Initially, the research team developed a twelve-session lesson plan for the theoretical unit on emergency situations in catastrophes. Each session was structured with the first half dedicated to topics delivered through a learning tree, scenario analysis, and clinical decision-making exercises. The subsequent half of each session, conducted weekly, employed Problem-Based Learning (PBL) techniques. In this phase, participants in the intervention group were divided into four groups of five individuals each. These groups discussed and summarized the session topics, with each group member contributing to written notes. Subsequently, one group member per group presented the summarized information to the other groups within the intervention group.

In contrast, the control group received traditional instruction consisting solely of lectures and slide presentations during the twelve-and-a-half-hour sessions. The content covered in these sessions mirrored that delivered to the intervention group, with identical topics

and the same instructor responsible for presentation (Figure 1).

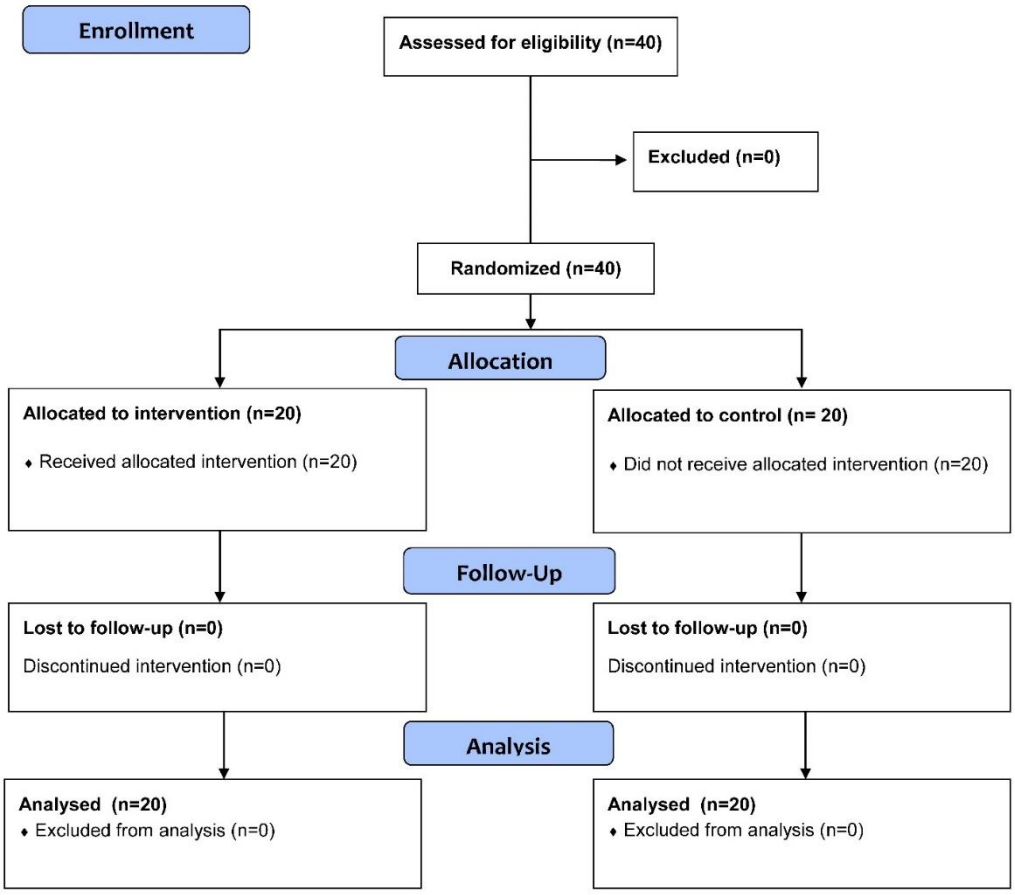


Figure 1. The Process of Allocating and Implementing the Study Protocol for Control and Intervention Groups.

Statistical Analysis

In this research, several statistical tests were employed to analyze the data. Chi-square tests were utilized to assess differences in demographic characteristics among various groups. Independent t-tests were conducted to compare score differences between groups. Paired t-tests were employed to evaluate changes in scores before and after interventions within the same group. Multiple linear regression analysis (full model) was used to examine the effects of the intervention on outcomes. Additionally, the Kolmogorov-Smirnov test was employed to assess the normal distribution of data.

A significance threshold of 0.05 was adopted for all statistical analyses. Data analysis was performed using SPSS version 16 software.

Results

First, the normal distribution of the data was confirmed using the Kolmogorov-Smirnov test, indicating that the data followed a normal distribution. Table 1 presents demographic characteristics of the study participants, showing that the majority were aged between 18 and 22 years, had a total average score ranging from 12 to 14, had 1-3 rejected units, were unemployed, and were single.

Using the chi-square test, no significant differences were found in demographic variables between the control and intervention groups.

Table 1. Baseline Characteristics of Students by Group.

Variable		Intervention	Control	P Value (chi-square)
Age	18 to 22	7 (35%)	11 (55%)	0.108
	23 to 27	8 (40%)	7 (35%)	

	Above 28	5 (25%)	2 (10%)	
Marital Status	Single	18 (90%)	13 (65%)	0.228
	Married	2 (10%)	7 (35%)	
Total average	Below 12	2 (10%)	1 (5%)	0.519
	12 to 14	15 (75%)	17 (85%)	
	15 to 17	1 (5%)	1 (5%)	
	Above 17	2 (10%)	1 (5%)	
Rejected units	No rejection	5 (25%)	3 (15%)	0.438
	1 to 3 units	12 (60%)	9 (45%)	
	Above 3 units	3 (15%)	8 (40%)	
Occupation	No	16 (80%)	14 (70%)	0.353
	Yes	4 (20%)	6 (30%)	

Based on the results presented in Table 2, initially, there was no significant difference in the mean ratings of Learning Satisfaction between the control and intervention groups before the intervention (P=0.304). However, following the intervention, this difference became statistically significant (P=0.021). Similarly, the average scores of Learning Rate in both the control and intervention groups showed no significant disparity before the intervention (P=0.257). Nevertheless, after the intervention, a notable and statistically significant difference was observed (P=0.012).

The independent t-test results indicate a statistically significant difference in the average scores of Learning Satisfaction and Learning Rate between the control and intervention groups (P=0.001).

Furthermore, examining within-group changes using paired t-tests, it was found that there was no statistically significant difference in the mean ratings of Learning Satisfaction within the control group before and after the intervention (P=0.107). In contrast, a significant difference was observed within the intervention group (P=0.003). Similarly, for the mean scores of Learning Rate, there was no significant difference within the control group before and after the intervention (P=0.086), but there was a significant difference within the intervention group (P=0.001).

These findings suggest that the intervention had a significant impact on both Learning Satisfaction and Learning Rate, demonstrating improvements in these measures compared to the control group.

Table 2. Comparison of Mean Learning Satisfaction and Learning Rate Before and After Intervention in Control and Intervention Groups.

Variable		**Group**		**Independent t-test**
		Control	Intervention	
		M ± SD	M ± SD	
Learning Satisfaction	Before	47.3 ± 3.12	44.1 ± 2.57	P= 0.304
	After	42.8 ± 2.26	58.9 ± 4.07	P= 0.021
Mean Difference		- 4.5	14.8	P=0.001
Paired t		P=0.107	P=0.003	--
Learning Rate	Before	10.53 ± 2.01	9.24 ± 1.62	P=0.257
	After	8.71 ± 4.55	12.38 ± 3.84	P=0.012
Mean Difference		- 1.82	3.14	P=0.001
Paired t		P=0.086	P=0.001	--

The results from multiple linear regression analysis demonstrate the impact of Problem-Based Learning (PBL) on the study outcomes, accounting for demographic variables and baseline values adjusted through backward modeling at a significance level below 0.05.

In the full model, PBL significantly influenced Learning Satisfaction, even after controlling for demographic variables and pre-PBL values (Coefficient=-41.1; 95% CI: -47.1 to -38.2; P<0.001; R-Squared=0.814). After employing a backward elimination approach to remove non-significant variables, PBL continued to have a

significant effect on Learning Satisfaction (Coefficient=-23.12; 95% CI: -56.71 to -19.41; P<0.001; R-Squared=0.879) (see Table 4).

Similarly, in the full model, PBL significantly affected Learning Rate, adjusted for demographic variables and pre-PBL values (Coefficient=-5.18; 95% CI: -8.36 to -5.01; P<0.001; R-Squared=0.866). Following the backward elimination process, which excluded ineffective variables, PBL maintained a significant effect on Learning Rate (Coefficient=-4.24; 95% CI: -6.06 to -3.72; P<0.001; R-Squared=0.802) (see Table 3).

These results underscore the substantial impact of PBL on enhancing both Learning Satisfaction and Learning Rate in the study, demonstrating its effectiveness beyond the influence of demographic factors and initial learning outcomes.

Table 3. Impact of Intervention on Learning Satisfaction and Learning Rate Analyzed by Multiple Linear Regression, Accounting for Demographic Characteristics.

Dependent	Model	Independent	Coefficient (CI %95)	P Value	R-Squared
Learning Satisfaction	Full model	Group (1= Intervention)	-41.1 (-47.1 to -38.2)	<0.001*	0.814
		Age (1=18-22)	-1.07 (-6.02 to 2.14)	0.414	
		Marital Status (1=Single)	-1.27 (-1.891 to 0.1.88)	0.698	
		Total average (1= 12-14)	-0.72 (-3.14 to 1.93)	0.573	
		Rejected units (1= no rejection)	-2.49 (-8.46 to 0.81)	0.067	
		Occupation (1=Yes)	-5.26 (-7.46 to 2.81)	0.304	
	Reduced model	Group (1= Intervention)	-23.12 (-56.71 to -19.41)	<0.001*	0.879
Learning Rate	Full model	Group (1= Intervention)	-5.18 (-8.36 to -5.01)	<0.001*	0.866
		Group (1= Intervention)	-0.25 (-1.27 to 1.86)	0.547	
		Age (1=18-22)	0.21 (-0.93 to 2.46)	0.701	
		Marital Status (1=Single)	-0.22 (-2.51 to 0.13)	0.446	
		Total average (1= 12-14)	-0.16 (-1.24 to 0.98)	0.308	
		Rejected units (1= no rejection)	-0.07 (-1.22 to 0.15)	0.599	
		Occupation (1=Yes)	-6.71 (-8.19 to 0.57)	0.435	
	Reduced model	Group (1= Intervention)	-4.24 (-6.06 to -3.72)	<0.001*	0.802

CI: Confidence Interval *: Significant Group: 1=Intervention, 2=Control.

Discussion

The present study compared the effectiveness of Problem-Based Learning (PBL) versus lecture methods in enhancing satisfaction with teaching and learning among emergency medicine associate students. Following the intervention using PBL, significant differences were observed between the control and intervention groups in mean scores of teaching satisfaction and learning rates.

Specifically, the use of PBL led to increased satisfaction with teaching and improved learning outcomes among students. These findings are consistent with Acquandoh et al. (17), whose study similarly demonstrated that PBL techniques enhance students' perceived knowledge and ability in PBL. Both studies highlight the significant positive impact of PBL on learning outcomes. Additionally, a systematic review (18) comparing various educational methods for medical students supports these results, indicating that innovative approaches like PBL, clinical decision-making, and simulation improve cognitive levels and learning rates among students.

Conversely, Fred Ssemugenyi's research (19), utilizing a mixed-methods approach, found no statistically significant difference in low-order learning outcomes between PBL and lecture methods. However, the lecture method showed advantages in higher-order learning characteristics immediately post-test. Their study suggests that while PBL may not significantly impact all learning parameters, it remains a valuable approach for enhancing certain aspects of learning.

In summary, the present study adds to existing literature by affirming the beneficial effects of PBL on teaching satisfaction and learning outcomes in emergency medicine associate students, aligning with broader findings in educational research.

The difference between this research and the current study may be attributed to several factors. Firstly, the discrepancy in sample sizes, with 8 participants in the intervention group in the previous research compared to 20 in the present study, could impact the statistical power and generalizability of findings. Additionally, variations in instructor competence, the specific content taught, and the capabilities of the study participants themselves are crucial factors influencing outcomes. Falahan et al. (20), in their study comparing lecture and PBL methods among dental students in orthodontic courses, support the findings of the current study. They reported significant improvements in internal motivation, sustained learning, and satisfaction with teaching among students taught using PBL compared to the control group. Both studies emphasize the effectiveness of PBL in enhancing teaching satisfaction and learning outcomes compared to traditional lecture methods. Active engagement in learning, problem-solving activities, and fostering sustained learning and teaching satisfaction are cited as reasons for the adoption and success of innovative teaching methods (21). Satisfaction with teaching is recognized as a critical component in improving learning quality and overall academic progress (22, 23). Numerous studies have shown that modern teaching methods such as role-playing, gamification, and PBL are well-received by learners and contribute to higher satisfaction levels, consistent with the findings of the present study (24).

In contrast, the lecture method, which focuses on content delivery in a teacher-centered manner, may not always engage learners effectively in active learning processes (25). Zhao et al. (26) found that while the lecture method may enhance memory retention and academic progress in certain contexts, it differed significantly from the findings of the present study. Factors contributing to such discrepancies could include differences in course structure, educational philosophy, and instructor expertise. While various factors contribute to differences between studies comparing teaching methods, the current research supports the benefits of PBL in enhancing teaching satisfaction and learning outcomes, underscoring its effectiveness in engaging students and fostering meaningful learning experiences. Despite the demonstrated benefits of Problem-Based Learning (PBL) in enhancing student satisfaction and learning outcomes, it is important for educators considering this method to recognize its limitations and challenges. PBL requires substantial skill and preparation from instructors to facilitate effectively. Moreover, its interactive and inquiry-based nature can be time-consuming, potentially challenging educators to cover all required educational content thoroughly. Nevertheless, the researchers of the current study advocate for the integration of PBL with traditional teaching methods. By combining PBL with more conventional instructional approaches, educators can capitalize on the strengths of both methods. This hybrid approach may enhance engagement, critical thinking, and application of knowledge among students while ensuring comprehensive coverage of educational content. Furthermore, the researchers suggest conducting further studies on PBL across different subjects and diverse student populations. Investigating the effectiveness of PBL in various contexts can provide insights into its adaptability and potential benefits across different disciplines and student groups. This continued research will contribute to refining educational practices and maximizing learning outcomes through innovative teaching methods. Among the limitations of this research, we can mention the small sample size, which was constrained by implementation limitations. Additionally, initial resistance from students and the challenge of covering all educational content within the semester posed further constraints.

Conclusion

The results of this study demonstrate that employing Problem-Based Learning (PBL) in teaching emergency and disaster scenarios is effective in enhancing teaching satisfaction and the learning rate of students. These findings can guide educators in making informed decisions about selecting teaching methods or integrating PBL with traditional approaches. Consequently, educators in the medical emergency department can deepen their understanding of PBL and implement it alongside traditional methods to enhance student learning outcomes.

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Conflict of interest

None of the authors have any conflicts of interest to declare.

Authors' contributions

SM: Conceptualization, Investigation, Supervision, Project Administration. ST: Conceptualization, Writing–Original Draft Preparation, Writing–Review & Editing, Supervision, Project Administration. HH: Methodology, Visualization. AV: Methodology, Validation, Formal Analysis, Resources, Data Curation, Visualization.

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