



Integration of Lecture and Role-Play in Teaching Immunology to Medical Students

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Abstract

Background: Medical education is viewed as a challenging phenomenon, which can cause stress in learners and affect the learning quality. Considering the importance of basic sciences education, development of new pedagogical approaches is necessary to improve medical education. Role-play is an efficient simulation-based approach, which can improve the students' perception and imagination. In basic sciences, immunology is of high relevance in clinical situations, as immunological disorders are becoming increasingly prevalent.

Objectives: Given the importance of deep learning in immunology, we integrated role-play in teaching immunology to medical students in order to promote deep and durable learning.

Methods: In this study, two independent classes of medical students were evaluated in two consecutive academic semesters in 2014 - 2015. In one class, only lectures were conducted, while in the other class, lectures, along with role-play, were integrated. Pretest and posttest scores were determined at the beginning and end of the semesters in both classes, and the scores were compared. Also, the students' point of view was studied using a questionnaire.

Results: The pretest score, which indicated the students' general knowledge of immunology, was not significantly different between the two classes. However, there was an increase in the score of students participating in the class, which integrated lecture and role-play. In addition, the score obtained by female students, who participated in the class with lecture and role-play, was significantly higher than that of female students in the lecture-based class. The results of the questionnaire revealed that the students were satisfied with the integrated teaching method and believed that their knowledge had improved.

Conclusions: Based on the findings, dramatization can make learning an exciting process and improve the students' understanding of immunology concepts.

Keywords: Medical Education, Immunology, Role-Play, Simulation

1. Background

Medical education is completed in a long period and includes a variety of subjects and courses. Medical students have a demanding curriculum, which may expose them to significant stress and mental pressure. In such circumstances, the students' learning quality and cognition may be negatively influenced. Therefore, development of new pedagogical approaches is necessary to improve the quality of medical education.

Since the clinical relevance of basic sciences is not properly understood by medical students, application of new educational methods for basic sciences is essential. Currently, use of simulation as an effective teaching ap-

proach has been advocated for medical students (1, 2). There are various types of simulation methods for medical education, including role-play, which has been shown to be an efficient tool for improving the students' perception and imagination (3, 4). It is generally important to promote a deep understanding of immunology among medical students, as knowledge of immunology concepts can improve decision-making in clinical situations (5, 6). However, medical students often find it difficult to understand the concepts of immunology using regular methods.

Notwithstanding the above, active learning associated with simulation activities, especially role-play, has not been used to teach immunology to medical students.

2. Objectives

Considering the clinical relevance of immunology as a basic science, we aimed to integrate role-play in teaching immunology to establish whether it can improve the medical students' learning.

3. Methods

3.1. Sampling and Study Setting

This interventional study, which aimed to propose an educational method, was performed on two groups of students. Two teaching methods, i.e. lecture and lecture plus role-play, were used to teach the immunology course, after which the academic performance of medical students was evaluated. The study population included all medical students, who were enrolled in the immunology course in 2014 - 2015. The students were from two independent classes in two consecutive academic semesters. They were randomly assigned to either the lecture-based group in one semester or the lecture-role play group in the following semester. The research setting was the Medical School of Alborz University of Medical Sciences, Alborz Province, Iran.

In the lecture-based group (n = 46), only lectures were conducted, while in the other group (n = 50), lecture, along with role-play, was integrated. The lectures were held every session, and the topic was presented in a small episode in which students played role of the immune systems elements discussed in that session. In addition, at the end of the all lecture sessions, the topics were dramatized by the students, who had enough time to review the materials during the lecture sessions. The final role-play session continued for almost three hours, during which all students participated in role-play at least once. The students watched other students' role-playing. Lectures were conducted in the faculty, and the final role-play was performed in the amphitheater hall of the faculty. The lecturer was the same for both groups, and none of the students dropped out of the study.

3.2. Study Process

Information, including age, sex, and grade point average (GPA) of both groups in two previous semesters, was collected from the training department, and differences between the groups were examined. In both lecture-based and lecture-role playgroups, ten immunology lectures (90 minutes) were conducted according to the Ministry of Health syllabus, using the same audiovisual equipment. In

the lecture-based group, a question-and-answer (Q&A) session was held after teaching all the basic concepts. On the other hand, for the lecture-role playgroup, lectures were conducted in the same manner as the lecture-based group, along with dramatization of the subject matter by the students.

The purpose of dramatization was to increase the students' perception of the role of immune system cells. Each student played the role of a component in the immune system. For instance, in a session related to complements, the role of each complement was played by the students, or in case of inflammation and diapedosis of immune cells, the students played the role of endothelial cells, neutrophils, and monocytes. At the same time, the name of each adhesion molecule (e.g., selectins and integrins), expressed during the process of inflammation by endothelial cells, was written on a sheet of paper. The students who played the role of endothelial cells displayed the sheet of paper. Subsequently, students who played the role of immune cells showed the corresponding ligand written on a sheet of paper.

Similarly, regarding the migration of antigen-presenting cells to lymph nodes, the students played the role of immune response elements to represent the antigen and trigger T-cell responses. To perform the role of each element in the immune system, each student was required to think about the function of the element and its time of action; this made the students reflect on every element of the immune system. Importantly, they noticed the connection between different elements and the order of communication among these elements. In the final session, when all topics had been covered, the students played the role of innate, humoral, and cellular immunity factors against an infectious agent.

The lectures in both classes had the same content and included an appropriate introduction to attract the students' attention and activate their previous knowledge. The content of the lectures was conveyed using appropriate examples, visual/audiovisual cues, and Q&A sessions. Also, engagement of students in the classroom was encouraged to increase their intellectual activity and the topics, along with the key points, were summarized.

3.3. Data Collection and Tools

At the beginning of each class, a similar 10-item pretest was performed for both classes to evaluate the general knowledge of students about immunology. At the end of the semester, similar paper-based exams, consisting of 40 questions (20-point scale), with the same difficulty and dis-

crimination indices, were performed, and the scores of the two classes were compared. The exams included different levels of questions on the students' knowledge, analysis, synthesis, and evaluation, according to Bloom's taxonomy. The students were questioned about their opinion and interest in the teaching method using questionnaire described previously (7).

3.4. Ethical Considerations

This study was carried out after obtaining approval under reference No.2342193 from the Ethical Committee of Alborz University of Medical Sciences. All class members were involved in the study, and there was no discrimination between the members of the groups. Also, there was no executive problem in either of the groups.

3.5. Data Analysis

To compare the final scores, *t*-test and Mann-Whitney U test were performed using Prism 6, when applicable. A significant difference was considered when $P < 0.05$. Data are presented as Mean \pm SD.

4. Results

4.1. General Educational Information

Data collected from the training department indicated that the students of both classes were in the third semester. The distribution of female and male students in the population of each class was nearly 73.6% and 26.4% in the lecture-based group, respectively, while in the lecture-role playgroup, female and male students comprised nearly 66.7% and 33.3% of the population, respectively. In terms of age, students in both groups were 19 - 21 years old. We evaluated the GPA of the two groups to determine if there is a significant difference. The maximum, minimum, and mean GPA scores in each group are shown in Table 1.

Comparison of the two groups showed that GPA of the lecture-based group was significantly higher than that of the lecture-role play group ($P = 0.02$). In addition, GPA of female students in the lecture-based group was significantly higher than that of female students in the lecture-role play group ($P = 0.03$). Conversely, there was no significant difference in the GPA of male students between the two groups ($P = 0.5$). The findings showed that the GPA of female students in each group was significantly higher than that of males in the same group ($P < 0.001$ for the lecture-based group and $P = 0.05$ for the lecture-role play group).

4.2. Pretest Results and Final Grades at the End of Semester

The pretest scores were not significantly different between the two groups. Statistical analysis of the final scores at the end of the semester showed that the mean score obtained by the lecture-role play group (15.65 ± 2.9) was significantly higher than that of the lecture-based group (14.47 ± 0.92) ($P = 0.02$; Figure 1). In addition, the final score of female students in the lecture-role play group (16.21 ± 2.9) was significantly higher than that of female students in the lecture-based group (14.61 ± 1.01) ($P = 0.017$). However, the final grade of male students was not significantly different between the two groups (14.61 ± 2.96 in the lecture-role play group and 14.12 ± 0.57 in the lecture-based group) ($P = 0.5$). The results suggest that lecturing plus role-play is more effective for female students than males. On the other hand, the difference in the final score of female (16.2 ± 2.9) and male (14.6 ± 2.95) students was significant in the lecture-role play group ($P = 0.04$). Nevertheless, no significant difference was observed between female (14.61 ± 1.01) and male (14.12 ± 0.57) students in the lecture-based group ($P = 0.1$).

The maximum and mode of final grade were higher in the lecture-role play group (max = 20; mode = 18), compared to the lecture-based group (max = 16.15; mode = 14.9). Moreover, the female students' grade in the lecture-role play group (max = 20; mode = 18) was higher than that of the lecture-based group (max = 16.15; min = 15.4). Also, the maximum grade of male students in the lecture-role play group was higher than that of the lecture-based group (19 vs. 14.9). However, the mode of male students' grade in the lecture-based group was higher than that of students in the lecture-role play group (14.65 vs. 14). These results suggest that lecturing along with role-play can improve the learning process of male students.

Comparison of female and male students in each group showed that the average score of female students was higher than that of male students in the lecture-role play group. Nonetheless, the mean scores of female and male students were not significantly different in the lecture-based group. Effect size (8) was also determined to determine the magnitude of significance. The measurements indicated that the effect size between the two groups was medium (0.6); however, the effect size for female students in the two groups was high (0.8).

4.3. Questionnaire Results

In the lecture-role play group, a survey was conducted to study the opinions of students (7). This survey was conducted in two stages, once before and once after role-play,

Table 1. Comparison of Maximum, Minimum, and Mode of GPA Between the Two Groups

	Lecture	Lecture+Role Play	Lecture (Female)	Lecture+Role Play (Female)	Lecture (Male)	Lecture+Role Play (Male)
Max.	18.68	18.42	18.68	18.42	16.33	17.15
Min.	14.46	13.76	14.62	13.76	14.46	13.88
Mode	15.98	16.01	15.4	18	14.65	14

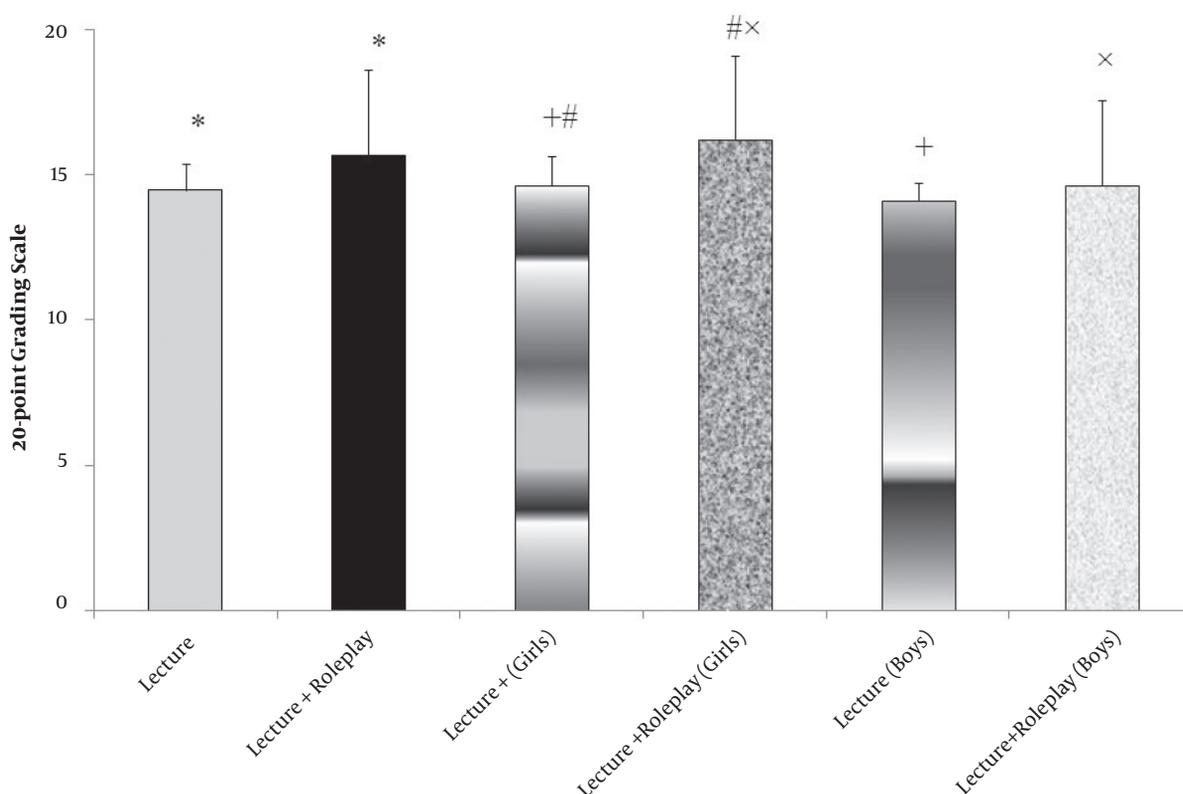


Figure 1. Comparison of final scores at the end of the semester in the two groups and female and male students (*and # represent significant differences [P < 0.05]; + and x represent relative differences [P = 0.1]).

using two forms to determine the students' point of view about role-play in the learning process. The students' responses to the questions in form 1 (questionnaire 1) are presented in Table 2. The results showed that 73.81% of students were satisfied with the teaching style, including 62.96% of girls and 93.75% of boys. Moreover, 100% of male students and 89.66% of female students were interested in entertainment education.

After role playing, form 2 (questionnaire 2) was used to determine the students' opinions, the results of which are shown in Table 2. The results indicated that the students' satisfaction with teaching increased from 73.81% to 83.33% after role-play; this increase was mainly due to the

increased satisfaction of female students from 62.96% to 77.27%. However, satisfaction of male students did not change significantly before and after role-play. Although 84.62% of females and 92.86% of males enjoyed lectures along with role-play, 100% of females and 92.86% of males believed that role-playing helped them learn and internalize the immunology concepts.

5. Discussion

Based on the hygiene hypothesis, immunological disorders are becoming increasingly prevalent worldwide. In some clinical situations, if not many, physicians do not

Table 2. Students' Opinions before and After Role-Play in the Two Groups and Female and Male Students (Based on the Questionnaire)

	Yes			No			Abstention		
	Female	Male	Class	Female	Male	Class	Female	Male	Class
Students' Response to the Questionnaire Before Role-Play									
Are you satisfied with the current teaching method?	62.96	93.33	73.81	37.04	6.67	26.19	0.00	0.00	0.00
Are you satisfied with your learning method?	57.14	93.33	69.77	42.86	6.67	30.23	0.00	0.00	0.00
Do you want to be an engaging teacher in the future?	89.66	100.00	93.02	10.34	0.00	6.98	0.00	0.00	0.00
Students' Response to the Questionnaire After Role-Play									
Are you satisfied with the teaching method?	77.27	92.86	83.33	0.00	0.00	0.00	22.73	7.14	16.67
Did you enjoy the class?	84.62	92.86	87.50	15.38	7.14	12.50	0.00	0.00	0.00
Did you gain what you expected at the end of the class?	100.00	92.86	97.50	0.00	7.14	2.50	0.00	0.00	0.00
Should this teaching methodology be included in the routine teaching program?	84.62	85.71	85.00	15.38	14.29	15.00	0.00	0.00	0.00

consider the immunological basis of the disease. They often investigate the infectious causes and neglect the immunological basis; therefore, patients do not receive appropriate treatment. On the other hand, drawing the medical educators' attention towards the importance and health impact of efficient immunology education can improve medical diagnoses and health services. Accordingly, emphasis on immunology teaching and learning is an important part of new educational methods for medical students.

Attempts have been made to evaluate different approaches, which seem suitable for teaching immunology (9, 10). In the present study, the effect of role-play, along with lecture, on the students' learning and performance was investigated during an immunology course. The purpose of dramatization was to increase the students' understanding of immune responses and to internalize the concepts. For comparison of GPA scores between the two groups at the end of the semester, the students' opinions about the effect of role-play on learning quality were determined using questionnaires. The results indicated that the final score of the lecture-role play group was significantly higher than that of the lecture-based group. Interestingly, GPA of the lecture-based class was higher than that of the lecture-role play class. Meanwhile, most students believed that role-playing improved the learning process. The students were satisfied with the teaching method and believed that it would be applicable in other classes. Also, a remarkable finding of this study was that students asked precise conceptual questions during role-plays.

The present findings suggest that role-play along with lecture makes the learning process more interesting and promotes a deep and durable understanding of immunol-

ogy concepts. With respect to the students' questions during role-plays, it seems that this method could also flourish the students' imagination, initiatives, and creativity. It should be noted that we repeated the procedure for the next two consecutive classes of medical students and obtained similar results (data not shown). Another interesting finding of this study is the similar efficiency of this method for female students.

The present results are consistent with previous findings from the United States, indicating the effectiveness of role-play in teaching immunology, regardless of class size (11). However, there are differences between our study and previous research, such as the students' field of study and method of role-play implementation (11, 12). One possible reason for the effect of dramatization on learning may be stimulation of the limbic system with auditory, visual, and kinesthetic cues for presenting information, while lectures involve aural, visual, and read/write learning styles. In addition, role-play integrates senses and emotions in learning, while lectures usually reduce the impact of senses and emotions (13, 14). Moreover, in role-plays, the learner, who becomes a part of the learning-teaching process, outlines the concepts; therefore, it is a unique self-learning approach, which exposes the student to challenges (11-15).

The present study is the first step towards the implementation of role-play in immunology education. It is important to analyze every student's final exam score in the lecture-based and lecture-role playgroups to determine if role-play improves higher-order thinking skills in students. One of the problems of this method is that it is not applicable to all courses. Also, it should be noted that people's interest in role-play can be different, and conse-

quently, the learning effects may vary. In addition, this method is labor-intensive for the instructor and increases his/her responsibilities, which may not be acceptable for many instructors. One of the important tasks of instructors in this area is to design and direct role-playing, which is demanding and requires an extra session. Meanwhile, in the present study, differences in the teacher's emotional state were inevitable in the two semesters.

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Footnotes

Authors' Contribution: Nafiseh Pakravan proposed the idea and developed by the help of the other authors. Nafiseh Pakravan performed the process with the help of the other authors. All of the authors have been involved in preparation of the article.

Conflict of Interests: The authors declare that there is no conflict of interest regarding the publication of this article.

Ethical Approval: This study was carried out after approval of the Ethical Committee of Alborz University of Medical Sciences. All of the class members were involved in the work, and there was no discrimination between the members of each group. There was no executive problem in either of the two groups.

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