

# Patient-oriented Problem-solving: An Effective Educational Tool for Learning Immunology

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## ABSTRACT


**Background:** Medical teaching requires innovative methods through which teachers can provide a student-centered learning environment that improves students' learning through their active participation. The patient-oriented problem-solving (POPS) system is an active learning tool that permits students to work in small groups to solve clinical problem, promotes self-learning, enhances clinical reasoning, and enriches their knowledge, and long-term memory. The aim of the study was to implement POPS session in immunology course and assess the students' perception of the effectiveness of POPS teaching in learning immunology. **Methodology:** 121 students were divided into small groups of 10 each. The pre-test questions were given to assess their previous knowledge before the POPS activity. Post-test questions were given after the activity to check the effectiveness of POPS session in learning. A questionnaire was also given at the end of the activity to assess the students' perception of POPS activity in learning. The data were collected, tabulated, and statistically analyzed. **Results:** Significant improvement in the mean differences between pre- and post-test scores of the students, suggests the effectiveness of POPS teaching activity. A majority of the students (>80%) stated that POPS promotes self-learning, creates interest, enhances conceptualization, empowers critical thinking, and problem-solving skills. **Conclusion:** POPS activity is a good educational method to enhance the learning skills of the medical students.

**Key words:** Active learning, clinical problem, immunology, patient-oriented problem-solving

## INTRODUCTION

Learning is a complex process that involves mental activities such as critical thinking and problem-solving ability. The medical undergraduate curriculum is comprised of many integrated subjects, broadly divided into basic sciences and clinical sciences. Clinical correlations in medical education are very important to assist medical students in connecting the concepts that they learn in basic sciences with the clinical sciences in diagnosis and management as they grow up.<sup>[1]</sup> This can be achieved only when undergraduate students

in their basic medical sciences years are trained in such a way that they obtain knowledge and can retrieve it when required.<sup>[2,3]</sup> In the majority of the medical schools, basic sciences are still taught by means of conventional methods such as didactic lectures. Such a system of education is teachers centered with minimal active participation from the students and is less effective in promoting students active learning and creativity.<sup>[4]</sup> Recently efforts have been widely undertaken to promote the student-centered education which stimulates active participation of the students and thereby facilitates their self-directed learning.<sup>[5]</sup> It is a challenge for the faculty to develop a learning tool that evokes students' interest, promotes self-directed learning, and enables learning association between a basic science concept and its applicability to medical practice in diagnosis and management.<sup>[6-8]</sup> Medical schools in different parts of the world have introduced various innovating teaching methods such as online quizzes, puzzles, and other problem-based learning activities to meet these challenges.<sup>[9-11]</sup>

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Patient-oriented problem-solving (POPS) activity is one such innovative learning method that permits students to work in small groups to solve clinical problems and thereby promotes self-learning, enhances intrinsic motivation, encourages clinical reasoning, and allows for knowledge retention and long-term memory.<sup>[12-14]</sup>

Immunology is a part of the 5<sup>th</sup>-year undergraduate 7-year MD curriculum at Oman Medical College. It is taught along with other integrated subjects, namely, Microbiology, Pathology, Pharmacology, and Physical Diagnosis and Clinical Integration. Immunology teaching involves basic definitions, terminologies, descriptions, and concepts in relation to pathogenesis and diagnosis of various immunological conditions such as autoimmune diseases, hypersensitivity reactions, transplant rejection, tumor immunology, and immunodeficiency diseases. Therefore, it is essential to teach using learning tools that enhance their conceptualization, problem-solving skills, and retention of knowledge and can be applied in their clinical practices for better diagnosis and management of diseases.

Hence, the objective of our study was to implement POPS for immunology teaching and assess students' perception of POPS activity in effective learning of the immunology course.

## MATERIALS AND METHODS

The study involves 5<sup>th</sup>-year undergraduate medical students (121 students) of Oman Medical College. The current study was approved by the Institutional Research and Ethical Committee. Informed consent from the students was obtained. For the current research, we chose hypersensitivity reactions. A POPS teaching package on an immediate type of hypersensitivity reaction, which was originally developed by Parker A Small and his associates (<http://www.Micro.musc.edu/pops/cases/hypersensitivityPOPS.pdf>) was used for the activity.

The topic was taught in detail in the regular lectures using PowerPoint slides and audiovisual aids. Two weeks later, POPS activity on the topic was scheduled with prior information to the students.

POPS activity was scheduled for 2 sessions of 2 h duration each with an interval of 1 week between the sessions. The batch was divided into 4 groups of 30 students each. Within each group, students were divided into subgroups of 10 each for ensuring all students actively participate in the discussion.

After briefing about rules and regulations of the activity, students were given a pre-test with 10 questions on the chapter of "immediate type of hypersensitivity" to evaluate

their basic knowledge acquired during the classroom lecture. The students were then distributed a booklet consisting of clinical case scenario and set of questions as originally developed by Parker A Small and his associates. An example of the POPS exercise is given in Appendix A. Students were asked to discuss the case in detail to understand the various concepts, generate learning issues, and to solve the clinically related questions given in the booklet. At the end of the activity, all students were given a set of predetermined post-test questions to check the effectiveness of POPS activity in learning. A questionnaire on the perceptions of the students regarding the usefulness of POPS activity in teaching and learning was also distributed to all the students. The evaluation was performed on a 3-point Likert scale (3 = strongly agree, 2 = moderately agree, and 1 = disagree). The data were collected, tabulated, and statistically analyzed.

## RESULTS AND ANALYSIS

A total of 118 students out of 121 enrolled in the class of batch 2019 attended and evaluated the POPS activity. An anonymous questionnaire survey was developed to assess the student's perceptions of POPS activity as a tool to enhance their learning. The questionnaire consisted of 10 statements with a 3-point Likert scale (strongly agree, moderately agree, and disagree) to assess the responses of the students in relation to various outcomes of the activity [Table 1]. In addition to the 10 questionnaire statements, students were asked to provide additional comments regarding the activity if they desired.

Of the 10 questions answered by the students, 90% of the students strongly or moderately agreed that POPS activity provided benefits in terms of long-lasting memory and it made them more absorbed during the activity. Over 80% of the students indicated that POPS activity facilitated self-learning, raised their interest in topic discussion, strengthened their intrinsic motivation, and improved their problem-solving skills. In addition, many of them opined that POPS is a more scientific way of medical teaching. All of these results suggested that most students were in favor of this new method of teaching. Notably, however, 24% of the students disagreed that POPS is helpful in making the diagnosis in real clinical practice. In their opinion, simulated clinical case scenarios are different from the actual clinical cases.

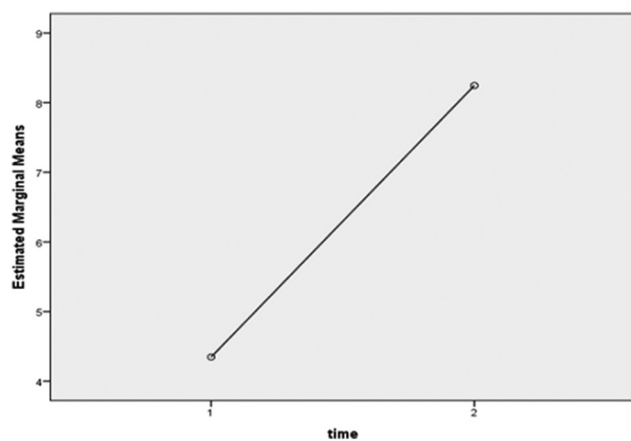
## Statistical analysis of pre- and post-test results

Test scores	No. of students (N)	Mean±standard deviation
Pre-test	118	4.35±1.215
Post-test	118	8.25±5.995

A repeated measures ANOVA with a Greenhouse-Geisser

**Table 1:** Results of POPS questionnaire answered by the students

Q.no.	Questions	Strongly agree	Moderately agree	Disagree	Mean (SD)
1	Do you agree that POPS develops your self-directed learning skills?	33	68	17	1.067 (0.32)
2	Do you agree that POPS should be used more frequently?	41	54	23	1.076 (0.36)
3	Do you agree that POPS will help you to make diagnosis in real clinical practice?	38	52	28	1.040 (0.37)
4	Do you agree POPS improves your problem-solving skills?	40	59	19	1.088 (0.34)
5	Do you agree that POPS creates interest in topic?	44	51	23	1.088 (0.36)
6	Do you agree that POPS make you more absorbed during the class?	57	50	11	1.194 (0.32)
7	Do you agree that POPS is a more scientific way for medical teaching?	49	50	19	1.127 (0.35)
8	Do you agree that POPS strengthens your intrinsic motivation for studying?	45	56	17	1.118 (0.34)
9	Do you agree that self-reading ahead of the class benefits material understanding	54	48	16	1.161 (0.35)
10	Do you agree that POPS provides benefits in terms of long-lasting memory?	52	54	12	1.169 (032)



This revealed that POPS training elicited an increase in score from pre-training to post-training ( $4.35 \pm 1.21$  vs.  $8.25 \pm 0.79$ , respectively), which was statistically significant ( $P \leq 0.0001$ ). Therefore, we can conclude that the POPS training elicits a statistically significant increase in scores. This suggests that POPS activity is effective in students learning.

## DISCUSSION

The aim of our study was to assess students' perception of POPS as a creative and interactive educational means to strengthen their learning skills. In conventional teaching methods such as didactic lectures, students become passive learners. As a consequence of this, the extent of students' motivation and curiosity in learning depends on the quality of teacher-centered performances.<sup>[15-17]</sup> In contrast to these traditional teaching methods, POPS module found to be an innovative technique introduced in medical education and is included in the curriculum of the many of the medical schools worldwide.<sup>[18,19]</sup> Previous studies have shown that POPS teaching strategy strengthens the students' active learning by allowing them to take charge of their own

learning, define learning objectives by themselves, and learn to work in a group.<sup>[2,4,20-22]</sup> The POPS also provides an opportunity to exchange information, discuss the problem with other students, and peer-assisted gathering of new information. This enhances their self-directed learning skills, critical thinking, and ability to solve clinical problems by linking multiple pieces of information and thereby it enriches their knowledge and long-term memory.<sup>[12-14,20-22]</sup> In our study, most of the students (>80%) favored the use of POPS module in teaching immunology. They stated that POPS module provided them an opportunity to interact better with classmates and enhanced their intrinsic motivation to do self-directed learning. It boosted their clinical reasoning ability and problem-solving skills. In addition, they opined that POPS improved their overall learning skills, knowledge retention, and long-lasting memory.

## LIMITATION OF THE STUDY

We believe that our study has some limitations. First of all, conclusions drawn from a single trial, needs to be enhanced by more trials and a longer time of study. Second, limited teaching resources such as shortage of teachers with enough experience in POPS may hinder wide application of the activity. Finally, preparation of POPS teaching module is time-consuming for teachers in medical universities, who have to spend great deal of time in clinical and research activities and it may affect the outcome of the activity.

## CONCLUSION

From the results of our study, it can be concluded that implementation of POPS module in immunology course improves students' motivation in learning, clinical reasoning ability, clinical problem-solving ability, and provides great opportunity to enhance their knowledge and long-term memory.

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## APPENDIX A

### An example of POPS and related questions on hypersensitivity reaction

Harry Hoofit, an outdoorsman whose main hobby is hiking, has just come to your office. This morning, while alone on a nearby trail, he was stung on the left forearm by an unknown species of insect. He felt immediate pain and his arm began to swell, but he had been bitten many times before and therefore paid no attention to the sting. Within a few minutes, however, he became very apprehensive, became short of breath, and experienced increasing difficulty in breathing until he passed out. When he awoke, his entire arm was markedly swollen and difficult to move because of the swelling. He had hives (raised, white, and itchy blotches) all over his body. He is not sure how long he was unconscious but believes it was at least 10 min but not more than 1 h. He also discovered that his underwear and pants were wet; he thinks he urinated while unconscious. He is naturally concerned and wants to know three things:

1. What caused this frightening event?
2. Might it happen again?
3. If so, can you help him?

#### Pre-test questions:

1. The wheel of a wheal-and-flare reaction
  - a. Occurs 24-72 h post-injection.
  - b. Is caused by edema resulting from the histamine induced capillary permeability.
  - c. Is caused by vasodilatation and increased blood flow.
  - d. Can be induced by haptens.
  - e. None of the above.
2. A "RAST" assay
  - a. Is usually used to determine the amount of blocking antibody in a patient's serum.
  - b. Proves what allergen is causing a patient's allergy.
  - c. Requires an insolubilized allergen and radiolabeled anti-IgE.
  - d. Is the "ragweed allergy standard test."
  - e. Gives the same information as a skin test.
3. Which of the following substances stabilizes mast cell membranes and thereby reduces release of histamine from mast cells?
  - a. Cromolyn sodium.
  - b. Antihistamines.
  - c. Epinephrine.
  - d. Blocking antibody.
  - e. None of the above.
4. The principal difference between asthma and allergic rhinitis is that
  - a. Asthma occurs year round, and allergic rhinitis occurs only in late summer.
  - b. Asthma is an allergy, and allergic rhinitis is psychogenic.
  - c. Asthma affects mostly females, and allergic rhinitis affects mostly males.
  - d. Asthma affects the lower respiratory tract, whereas allergic rhinitis affects the upper respiratory tract.
  - e. Asthma can be diagnosed with skin tests, but allergic rhinitis must be diagnosed with the RAST assay.
5. Which of the following substances inhibits allergic disease by preventing the antigen from reaching the reagenic antibody fixed to the mast cell?
  - a. Cromolyn sodium.
  - b. Antihistamines.
  - c. Epinephrine.
  - d. Blocking antibody.
  - e. None of the above.

6. Which of the following cytokines is believed to be the primary determinant of a vigorous IgE response to an allergen?
  - a. IL-2.
  - b. IL-4.
  - c. IL-5.
  - d. IL-12.
  - e. IL-13.
7. Mast cells and basophils are very similar in that they both
  - a. Have receptors on their surfaces that bind the Fc region of IgM.
  - b. Are found in the blood.
  - c. Have granules that contain histamine.
  - d. Stain with acidophilic dyes.
  - e. Synthesize antibodies.
8. A patient who is allergic to ragweed developed IgE myeloma. The myeloma IgE does not react with the ragweed pollen. What would be the effect of his myeloma on the severity of his allergic symptoms during hay fever season?
  - a. No change.
  - b. It would increase due to his having more circulating IgE.
  - c. It would increase due to the blocking effect of then myeloma.
  - d. It would decrease due to competitive inhibition of IgE anti-ragweed binding to mast cell receptor sites by myeloma IgE.
  - e. It would decrease due to competitive inhibition of IgE anti-ragweed binding to ragweed allergen by myeloma IgE.
9. The usual sequence of events in an allergic reaction is as follows:
  - a. The allergen combines with circulating IgE and then the IgE: allergen complex binds to mast cells.
  - b. The allergen binds to the IgE already fixed to mast cells.
  - c. The IgE binds allergen in the blood and then binds to histamine receptors.
  - d. The allergen is processed by macrophage and then binds to mast cells.
  - e. The allergen combines with IgG.
10. Complement
  - a. Is never involved in allergic reactions.
  - b. Can be fixed by IgE antibody-antigen complexes.
  - c. Can produce anaphylaxis by release of anaphylotoxin (C3a and C5a) when complement is fixed.
  - d. Is involved in allergic rhinitis.
  - e. Can lyse mast cells releasing IgE.