



A PERCEPTIONS ASSESSMENT OF PATIENT-ORIENTED PROBLEM-SOLVING TEACHING STRATEGY FOR MEDICAL IMMUNOLOGY COURSE IN CHINESE STUDENTS

Abstract. *This research assessed the perceptions of students to patient-oriented problem-solving (POPS) teaching strategy in a medical immunology course in China.*

Data were collected from second-year students (N=71; 58% males, 42% females) who were offered lecture-based instruction and POPS teaching strategy during October - November 2015 at Lanzhou University. Afterward, students' response and capability perception scores to POPS teaching strategy were evaluated using questionnaires. The majority of students (89.02%) favored POPS teaching strategy over traditional lectures. Students responded that POPS improves their intrinsic motivation (91.55%), learning interest (94.37%), self-directed learning skills (92.96%) and feasible for medical education (87.32%). Compared to the traditional lectures, the POPS can improve markedly their learning motivation ($p=0.03$), clinical reasoning ability ($p=0.01$), and clinical problem-solving ability ($p=0.02$). The implementation of POPS in medical courses will help students improving their learning motivation, problem solving abilities, which is feasible for current medical immunology education in China.

Key words: *active learning, medical education, patient-oriented problem-solving, undergraduate, China.*

**Xingming Ma,
Lifeng Zhang,
Jingqiu Wang,
Yanping Luo,
Yaling Liang,
Yufeng Wu**

Introduction

For the medical students of clinical science, it is very important to acquire and apply basic medical sciences knowledge into clinical practice in future. One of the major medical education goals is to train quality physicians who will be successful in dealing with clinical practice in a fast changing modern hospital environment (IIME, 2002; Zhiren, Wei, Junfeng, Sheng & Yuzhang, 2013; Xingming, Yanping, Jingqiu, Lifeng, Yaling, Yufeng, Hongjuan & Mingqiang, 2016). Physicians of the future must understand the scientific basis of clinical medicine and be able to apply that understanding to the practice of medicine (IIME, 2002; Shaohua, Daixin & Man, 2014). Medical immunology is one of the basic medical sciences that forms the foundation for developing reliable clinicians (Armson, Meyer, Losco, Ardakani & Walker 2016). Immunology education in China usually depends on lecture based instruction and rote learning instead of their own research with the help from their peers and promotion of active learning and creativity (Zhiren et al., 2013; Guo Y, Sippola, Feng, Dong, Wang, Moyer, & Stern, 2009; Xingming et al., 2016). Mostly because of the large population, culture and history, Chinese medical education meets with different social questions than those in many developed countries (Zhiren et al., 2013; Guo et al., 2009; Xingming et al., 2016). Nowadays, for China's medical schools, the greatest challenge is the training of qualified clinicians who can both adjust to a rapidly hospital environment, and simultaneously satisfy the requirements of Chinese people. In order to improve medical students' creativity and promote active learning, attempts have been made in medical schools to develop skill-oriented syllabi and practices by including approaches based on organ systems, patient-oriented

**Xingming Ma, Lifeng Zhang,
Jingqiu Wang, Yanping Luo,
Yaling Liang, Yufeng Wu**
Lanzhou University, China



problem learning and information technology (Zhiren et al., 2013; Shaohua, Daixin & Man, 2014; Aljarallah & Hassan, 2015; Xingming et al., 2016).

The patient-oriented problem-solving (POPS), an educational method of problem learning, provides students with a patient case to relate content learned in the classroom (Ingenito & Wooles, 1995; Lathers & Smith, 2002; Singh, 2011; Zhiren et al., 2013). The main purpose of POPS exercises is to provide a conceptual framework for applying immunology principles to clinical situations to be used by medical students. POPS was widely applied to various subjects with different forms in Asian schools (Ghosh, 2007; Singh, 2011). Compared with traditional lecture, the POPS can be more helpful for training peer interaction, problem-solving skills (Ingenito et al., 1995; Zhiren et al., 2013). In particular, the backgrounds of culture, history and philosophy in China are distinct from those in western countries. Some instructors still have doubts about its benefits for Chinese medical educational environment and students. The hypothesis in this research was that students would have a positive attitude towards this course in response to the POPS teaching strategy.

Problem of Research

The previous studies indicated that the POPS may be an available alternative to problem based learning in large population countries such as India and China (Ghosh, 2007; Singh, 2011). Since 2012, the attempt of POPS mode in China has been made for basic medicine curricula in some medical schools (Zhiren et al., 2013; Xingming et al., 2016). Although POPS could be a favored option over the conventional lectures, some instructors still have doubts about its benefits for medical education, and point out that POPS system may not be feasible for Chinese medical educational environment and students. **In this research, a trial of POPS teaching strategy in medical immunology course was tried on second-year students who majored in clinical medicine and the perceptions of students to POPS were evaluated.**

Research Focus

The education reform and innovation was attempted by many medical schools to improve medical students' creativity, promote active learning and meet the requirements of the medical education system in China (Zhiren et al., 2013; Xingming et al., 2016). Tetanus immunity was chosen as the learning subject for second-year Chinese students. The students' test scores were evaluated before and after teaching. A feedback questionnaire to POPS teaching strategy was then finished by students who witnessed the whole teaching process. The results of this research can be utilized by educators to promote active learning and encourage the use of POPS strategy for more effective medical immunology education in China.

Methodology of Research

General Background of Research

The medical immunology course, approximately 11 week's duration, was offered during the autumn semester in each academic year at Lanzhou University. A weekly schedule in this course included four hours of didactic lectures (total 44 hours) and one laboratory session (total 28 hours) of two or four hours duration. In general, the topics of each chapter on medical immunology course were taught through traditional didactic lecture mode given by the instructors. The teachers answered students' questions and repeated any points that had not been fully understood. In the current research, we chose one of the chapters as the learning subject in the whole process of POPS mode. A subsequent POPS teaching activity was implemented by four stages (pre-test, discussion, solution and post-test), and questionnaires were conducted to assess the perceptions of students on POPS strategy.

Sample of Research

A total of 71 second-year students who majored in clinical medicine were enrolled in the medical immunology course of this research during October - November 2015 at School of Basic Medical Sciences, Lanzhou University. In a total of 71 students, 30 students were female and 41 students were male. All participants were enrolled in a mandatory medical immunology course, which was delivered through traditional lecture-based instruction and



POPS mode. Moreover, participants who completed the questionnaire survey also filled out an informed consent form agreeing to participate in the study. Students in POPS mode were briefed on the study purpose and process, and without any adverse effect on this course grade. Before the study, approval was obtained from the curriculum development committee and ethics committee at School of Basic Medical Sciences, Lanzhou University in China.

Instrument and Procedures

This cross-sectional research was conducted to assess the perceptions of medical students regarding POPS. Seven weeks after traditional lectures, a trial of POPS teaching strategy was introduced to this class and lasted a total of 8 hours. Tetanus immunity was chosen as the learning subject and used for students in the whole process of POPS teaching activities. Four examples of the POPS exercise and test questions on tetanus immunity were freely obtained from internet (<http://www.learningace.com/>) and translated into Chinese to be used. The program was strictly carried out in accordance with the POPS manual, and conducted over 4 sessions, two hours per session. Briefly, students first reviewed the attached set of objectives, did background reading on the topics to be covered, and completed the pre-test on their own. In the second phase, students reviewed the pre-test answers in an "open-book" discussion. In the third phase, students solved patient-oriented problems of four POPS exercise. Information exchange and peer interaction were keys to the success of this phase. The role of the facilitator was to help students focus on learning objectives, ensure group dynamics and summarization. Finally, students completed the post-test, individually, and then summarization of the most appropriate solutions was made by the facilitator.

Evaluation Methods

After the end of this course, a questionnaire paper with 10 questions was conducted among the students. The student responses were in the YES/NO pattern. Capability perceptions on POPS were recorded using a separate questionnaire in which responses were graded on Likert scale from strongly agree to strongly disagree according to the syllabus of course. Students scored statements according to their perceptions from 1 (strongly disagreeing) to 5 (strongly agree), and total perception scores were calculated. The questionnaire was developed according to the findings of previous studies and was reviewed and validated by medical education experts. All participants finished anonymously the questionnaires for assessing the perceptions of POPS in this research.

Data Analysis

The scores of POPS and lecture based instruction were compared by paired t test through SPSS 19.0 for Windows software (SPSS, Inc., Chicago, IL, USA). The significance level was defined as $p < 0.05$.

Results of Research

In a total of 71 students with a mean age of 20.5 ± 1.36 , 30 students were female and 41 students were male. The average scores obtained in the pre-test and post-test were 3.20 ± 1.67 and 8.85 ± 1.06 , respectively ($p < 0.001$) (Figure 1). There was a statistically difference in the test scores and the percentage of high post-test scores (marks ≥ 8) was up to 69% (49/71).

Questionnaire feedback results from 71 students were shown in Table 1. Perceptions of POPS teaching strategy were agreement on 89.02% of students, and negative response in 10.98%. Students responded that POPS improves their intrinsic motivation (91.55%), learning interest (94.37%), self-directed learning skills (92.96%), feasible for medical education (87.32%) and benefits in terms of long-lasting memory (87.32%). The average sums of the perception scores in the POPS and traditional lecture based instruction were 34.94 ± 4.68 and 33.99 ± 3.87 in Table 2, respectively, which was no significant difference in students' capability perceptions with the educational method ($t = 1.33$, $p = 0.19$). However, there were significant different perception scores in the learning motivation ($t = 2.24$, $p = 0.03$), clinical reasoning ability ($t = 2.65$, $p = 0.01$), clinical problem-solving ability ($t = 2.32$, $p = 0.02$) between POPS and traditional lecture-based instruction.



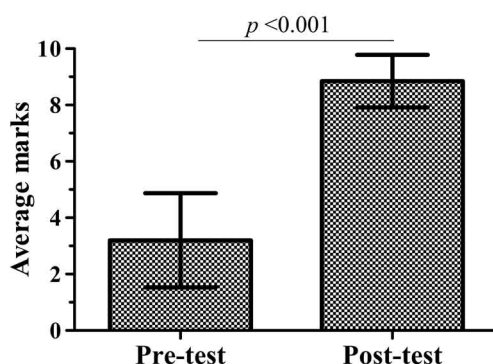
Table 1. Students' response to patient-oriented problem-solving (POPS) teaching strategy (n = 71).

| Questions | Yes (%) | No (%) |
|--|--------------|-------------|
| Compared with traditional lecture-based instruction, do you think: | | |
| 1 POPS should be used by more immunology teachers? | 63 (88.73) | 8 (11.27) |
| 2 POPS is a more scientific way for medical teaching? | 59 (83.10) | 12 (16.9) |
| 3 POPS creates your interest in learning immunology? | 67 (94.37) | 4 (5.63) |
| 4 POPS strengthens your intrinsic motivation? | 65 (91.55) | 6 (8.45) |
| 5 POPS develops your self-directed learning skills? | 66 (92.96) | 5 (7.04) |
| 6 POPS improves you problem-solving skills? | 67 (94.37) | 4 (5.63) |
| 7 POPS helps you prepare for exams of immunology | 61 (85.92) | 10 (14.08) |
| 8 POPS provides the benefits in terms of long-lasting memory? | 62 (87.32) | 9 (12.68) |
| 9 POPS helps you understanding the course objectives? | 60 (84.50) | 11 (15.50) |
| 10 POPS is feasible for current educational environment? | 62 (87.32) | 9 (12.56) |
| Average% | 63.6 (89.02) | 7.8 (10.98) |

Table 2. Capability perception scores to POPS teaching strategy and lecture based instruction (mean±SD) (n = 71).

| Question/ statement | POPS teaching strategy | Lecture based instruction | t (p) |
|--|------------------------|---------------------------|-----------------------------|
| Increase learning motivation | 4.55±0.81 | 4.23±0.91 | 2.24 (p =0.03) [▲] |
| Promote self-directed learn skills | 4.31±0.82 | 4.26±0.89 | 0.29 (p =0.77) |
| Improve peer interaction | 4.14±0.89 | 4.20±0.82 | -1.07 (p =0.29) |
| Extent more related knowledge | 4.23±0.88 | 4.34±0.82 | -0.79 (p =0.43) |
| Help to memory basic knowledge | 4.42±0.90 | 4.45±0.80 | -0.20 (p =0.85) |
| Enhance clinical problem-solving ability | 4.54±0.73 | 4.20±0.98 | 2.32 (p =0.02) [▲] |
| Enhance clinical reasoning ability | 4.45±0.84 | 4.07±0.86 | 2.65 (p =0.01) [▲] |
| Enhance communication skills | 4.31±0.95 | 4.14±0.97 | 1.04 (p =0.29) |
| Sum of perception scores (5×8=40) | 34.94±4.68 | 33.99±3.87 | 1.33 (p =0.19) |

Students scored statements according to their perceptions from 1 (strongly disagreeing) to 5 (strongly agree), and total perception scores were calculated. [▲]p < 0.05

**Figure 1: The average scores obtained in the pre-test and post-test (mean±SD) (n = 71).**

Discussion

For many years, the conventional teaching style, teacher-centered instruction, has been dominant in higher education in China. In a traditional classroom, students become passive learners, or rather just recipients of teachers' knowledge (Ernest, Anand, Kanagasabapathy, Chandy, Kuruvilla & Thomas, 1998; Maojuan, Xijuan & Huan, 2014). As a consequence, the extent of students' motivation and curiosity greatly relies on the quality of conventional teacher-centered performances. This methodology has been criticized by many pedagogic scientists (Shaohua et al., 2014, Xingming et al., 2016).

POPS, an interactive teaching strategy, was first introduced into medical education system in late 1960's, and has been extensively used in various subjects in worldwide schools for teaching first- or second-year students without clinical experience, especially in the western countries (Ingenito et al., 1995; Lathers et al., 2002; Singh, 2011; Zhiren et al., 2013). **Some instructors in China addressed that POPS may not be feasible for Chinese medical education** because the POPS teaching increases the extra workload for them and limited resources such as inadequate databases block widely adoption of POPS in medical schools (Zhiren et al., 2013). It is especially important that they ignored the eagerness and perceptions of students to POPS teaching strategy. This research showed that 83.10% 94.37% of students agreed that POPS provides self-directed learning approach and help them learning immunology course. Adoption of POPS strategy could strengthen the student active learning as they apply their own experiences and previous knowledge. The POPS also provides students with the opportunity to exchange information and discuss problems each other, which makes learners responsible for their own learning by self-directed, peer-assisted seeking of new information. The current research data shown that POPS helps to improve Chinese student problem-solving skills and create learning interest, which is a potentially powerful method for training students' ability and feasible on medical immunology course in China.

As compared to the lecture based instruction, there were significant increase of perception scores in the learning motivation, clinical reasoning ability, clinical problem-solving ability with the POPS teaching strategy. This teaching strategy permits medical students in a small group to work together to discuss and solve problems of clinical practice in the field of medical immunology course (Lathers et al., 2002; Zhiren et al., 2013; Xingming et al., 2016). Meanwhile, a significant difference in post-test and pre-test performance was observed, which indicated that POPS teaching strategy could help students understanding the subjects matter and mastery of knowledge on medical immunology course. POPS teaching strategy encourages students to actively create their own knowledge and independently develop solutions, rather than refer to the knowledge imparted to them by educators or textbooks for problem-solving. Thus, the introduction of POPS educational strategy would not only help the student gain requisite knowledge in immunology course but also enhance their problem-solving skills and learning motivation, which is a more feasible teaching method for current medical education in China.

Several limitations pertaining to this research must be considered when interpreting the findings. First, this research is limited by the sample size. Only 71 students were involved in this research of Lanzhou University. This may not fully allow for generalizing the findings to the general population of clinical science students. Second, the conclusions obtained from a single trial may be improved by more trials and a longer time research in China. The final limitation was that we did not consider the student's attitude in the current course and learning styles such as interactive or passive.

Conclusions

This research shows the perceptions of Chinese medical students to POPS strategy and traditional lectures mode. The majority of students favored POPS teaching strategy over traditional lectures. Compared to the traditional lectures, the POPS can improve markedly their learning motivation, clinical reasoning ability, and clinical problem-solving ability, which indicated that POPS is a powerful educational strategy for medical immunology course and is preferred by medical students to traditional lectures. The implementation of POPS in medical courses is feasible for current medical immunology education in China. However, the present research merely surveyed 71 students' perceptions of POPS education, prospective follow-up research on large scale including the immunology educators may be needed to confirm such effects in China.



References

- Aljarallah, B., & Hassan, M. S. (2015). Problem based learning (PBL) vs. Case based curriculum in clinical clerkship, internal medicine innovated curriculum, student prospective. *International Journal of Medical Sciences*, *9*, 147-52.
- Armson, A. J., Meyer, A. J., Losco, B. E., Ardakani, E. M., & Walker, B. F. (2016). Immunology knowledge as one of the basic sciences that forms the foundations to developing sound clinicians. *Journal of Chiropractic Education*, *30* (2), 108-113. doi 10.7899/JCE-15-12.
- Ernest, K., Anand, K. N., Kanagasabapathy, N., Chandu, S. J., Kuruvilla, A., & Thomas, M. (1998). Patient oriented problem solving (POPS) approach and audiovisual aided (AVA) lectures in teaching pharmacology-A comparative study. *Indian Journal of Pharmacology*, *30*, 97-101.
- Ghosh, S. (2007). **Combination of didactic lectures and case-oriented problem solving tutorials toward better learning: perceptions of students from a conventional medical curriculum.** *Advances in Physiology Education*, *31*, 193-197.
- Guo, Y., Sippola, E., Feng, X. L., Dong, Z., Wang, D. B., Moyer, C. A., & Stern, D. T. (2009). International medical school faculty development: The results of a needs assessment survey among medical educators in China. *Advances in Health Sciences Education*, *14*, 91-102.
- IIME Core Committee (2002). Global minimum essential requirements in medical education. *Medical Teacher*, *24*, 130-135.
- Ingenito, A. J., & Wooles, W. R. (1995). **Survey results of POPS use in United States and Canadian schools of medicine and pharmacy.** *The Journal of Clinical Pharmacology*, *35*, 117-127.
- Lathers, C. M., & Smith, C. M. (2002). Development of innovative teaching materials: clinical pharmacology problem-solving (CPPS) units: comparison with patient-oriented problem-solving units and problem-based learning-a 10-year review. *The Journal of Clinical Pharmacology*, *42*, 477-491.
- Maojuan, G., Xijuan, J., & Huan, D. (2014). An application of PBL in medical education. *China Higher Medical Education*, *10*, 92-93. (in Chinese).
- Shaohua, Y., Daixin, H., & Man, L. (2014). The effect of PBL teaching on creativity of forensic students. *China Higher Medical Education*, *11*, 112-113. (in Chinese)
- Singh, A. (2011). Student performance and their perception of a patient-oriented problem-solving approach with audiovisual aids in teaching pathology: a comparison with traditional lectures. *Advances in Medical Education and Practice*, *2*, 9-15.
- Xingming, M., Yanping, L., Jingqiu, W., Lifeng, Z., Yaling, L., Yufeng, W., Hongjuan, Y., & Mingqiang, C. (2016). Comparison of student perception and performance between case-based learning and lecture-based learning in a clinical laboratory immunology course. *LaboratoriumsMedizin / Journal of Laboratory Medicine*, *40*, 283-289.
- Zhiren, Z. H., Wei, L., Junfeng, H., Sheng, G., & Yuzhang, W. (2013). A trial of patient-oriented problem-solving system for immunology teaching in China: A comparison with dialectic lectures. *BMC Medical Education*, *13*, 11. doi: 10.1186/1472-6920-13-11.

Received: October 03, 2016

Accepted: December 05, 2016

| | |
|---------------------|--|
| Xingming Ma | MSc/PhD, Professor, Department of Immunology, School of Basic Medical Sciences, Lanzhou University, Donggang West Road No 199, Lanzhou, PR China, 730000. E-mail: maxm@lzu.edu.cn Website: http://jchxy.lzu.edu.cn/lzupage/2009/10/29/N20091029103612.html |
| Lifeng Zhang | MSc/MD, Lecturer, Department of Immunology, School of Basic Medical Sciences, Lanzhou University, Donggang West Road No 199, Lanzhou, PR China, 730000. E-mail: zhanglf@lzu.edu.cn |
| Jingqiu Wang | MSc/PhD, Lecturer, Department of Immunology, School of Basic Medical Sciences, Lanzhou University, Donggang West Road No 199, Lanzhou, PR China, 730000. E-mail: zhanglf@lzu.edu.cn |
| Yanping Luo | MSc, Associate Professor, Department of Immunology, School of Basic Medical Sciences, Lanzhou University, Donggang West Road No 199, Lanzhou, PR China, 730000. E-mail: luoyp@lzu.edu.cn |
| Yaling Liang | MSc/MD, Lecturer, Department of Immunology, School of Basic Medical Sciences, Lanzhou University, Donggang West Road No 199, Lanzhou, PR China, 730000. E-mail: liangyl@lzu.edu.cn |
| Yufeng Wu | MSc, Lecturer, Department of Immunology, School of Basic Medical Sciences, Lanzhou University, Donggang West Road No 199, Lanzhou, PR China, 730000. E-mail: wuyf@lzu.edu.cn |

