

The Effect of The BOPPPS Model With PAL And Medical Humanities Methods On Chinese Medical Students In Cardiopulmonary Resuscitation Courses

Chen Li (✉ lichenem@tmu.edu.cn)

Tianjn Medical University General Hospital

Song-tao Shou

Tianjn Medical University General Hospital

Yan-fen Chai

Tianjn Medical University General Hospital

Research Article

Keywords: cardiopulmonary resuscitation, education, BOPPPS teaching model, peer-assisted learning, medical humanities methods

Posted Date: October 12th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-918677/v1>

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Abstract

Background: The purpose of this study was to investigate the effect of the BOPPPS model (bridge-in, learning objective, pretest, participatory learning, posttest, and summary) with PAL (Peer-assisted learning) and medical humanities methods on Chinese Medical Students in Cardiopulmonary Resuscitation Courses.

Methods: Participants were the long-term medical students of Tianjin Medical University who accepted emergency medicine courses from 2015 to 2020. Forward-looking descriptive research and phased CPR curriculum teaching innovation, including the BOPPS with PAL (First Stage), the BOPPS with PAL and medical humanities methods (Second Stage), compared with the traditional teaching model (Basic Stage).

Results: The usual and final results improved in First stage compared with Basic stage ($\uparrow 30.2\%$, $\uparrow 7.5\%$), the proportion of those with more than 80 points increased in the usual exam, and the proportion of those with 70 points or more increased in the final exam. The usual and final results improved in Second stage compared with First stage ($\uparrow 12.0\%$, $\uparrow 2.2\%$), the proportion of those with more than 90 points increased in the usual exam, and the proportion of those with 80 points or more increased in the final exam.

Conclusions: The teaching innovation of the CPR curriculum, the application of BOPPPS teaching model, and the peer-assisted learning and medical humanities teaching methods can improve teaching quality of CPR courses in medical colleges.

Background

Emergency medicine is a relatively young secondary discipline of clinical medicine. The teaching of emergency medicine is still being explored. Cardiopulmonary resuscitation (CPR) is the cornerstone of emergency medicine teaching[1]. No matter which major medical students pursue after graduation, the implementation of CPR is an essential skill in clinical work. However, in clinical work, the overall success rate of CPR in China is still low[2]. The reason is related to the cognitive level and operational ability of the performer of CPR. Achieving high-quality CPR is difficult[3]. Educators are constantly exploring breakthrough points in CPR teaching[4–7].

Various clinical assessments show that most clinicians do not know much about CPR, and their cognitive level floats on the surface; thus, fully meeting the requirements during the operation is difficult. In clinical work, the compression frequency and ventilation frequency during CPR are much higher than the prescribed requirements[8, 9]. The finding above makes us reflect on the course of CPR. The purpose of teaching is not only to teach students how to do it, but also to make them comprehend why it is done, so that they can understand the treatment methods in principle, master high-quality CPR[10], and enter clinical work smoothly. The purpose of this research is to implement teaching innovation for CPR courses in medical colleges and universities, and analyze the effects of teaching innovation.

Methods

2.1 Object

The object of this study is the long-term medical students of Tianjin Medical University who accepted emergency medicine courses from 2015 to 2020. The usual grades and final grades of the CPR course were recorded. Inclusion criteria: from 2015 to 2020, long-term medical students who took emergency medicine courses. Exclusion criteria: those who withdrew from the course halfway and those who did not participate in the CPR course.

2.2 Methods

This research is a forward-looking descriptive study. The traditional teaching from 2015 to 2016 was introduced in the basic phase. The BOPPPS teaching model (bridge-in, learning objective, pretest, participatory learning, posttest, and summary) with PAL (Peer-assisted learning) methods was introduced in the first phase (2017–2018). The BOPPPS with PAL and medical humanities teaching methods were introduced in the second phase (2019–2020). The students' usual grades and final grades for the CPR course were recorded. The year-on-year trend of the above achievements was observed.

2.2.1 BOPPPS teaching model

The BOPPPS teaching model emphasizes student participation and closed-loop feedback, and has six stages, namely, Bridge-in, Objective, Preassessment, Participatory Learning, Post assessment, and Summary[11].

2.2.2 PAL

The PAL teaching method is a teaching strategy based on peers' mutual photos. Teachers and students exist as a learning community of "companions," which promotes the interaction between teachers and students and that between students and students[12].

2.2.3 Medical humanities methods

Medical humanities is a form of constructing a pattern of full-staff, full-process, and full-course education. It is a comprehensive educational concept that combines various courses with humanistic elements to form a synergistic effect and regard moral education as the fundamental task of education[13].

2.3 Statistics

The data obtained are entered into the computer and processed using SPSS17.0 software. Quantitative data are tested for normality (K-S method). Quantitative data of normal distribution are represented by mean \pm standard deviation ($\bar{x} \pm S$), and data of non-normal distribution are represented by median, minimum, and maximum. Descriptive statistical methods are used to describe the distribution of data

characteristics, and the comparative analysis method is used to compare historical data over the same period.

Results

3.1 Comparison of the results of emergency medicine courses from 2015 to 2020

The comparison results of the CPR and final scores of the emergency medicine courses from 2015 to 2020 show that the usual scores and final scores of the first stage are improved compared with the traditional stage; the usual scores and the final scores are improved in the second stage compared with the first stage (Table 1).

Table 1

Comparison of the usual (CPR) and final results of emergency medicine course from 2015 to 2020.

Phase	Years	Usual grades	Usual year-on-year	Final grade	Final year-on-year
Basic	2015 (n = 91)	66.7 ± 7.3	-	69.8 ± 6.0	-
	2016 (n = 94)	67.1 ± 8.1		70.6 ± 6.0	
First	2017 (n = 92)	91.7 ± 11.2	↑30.2%	79.0 ± 6.1	↑7.5%
	2018 (n = 84)	82.5 ± 12.9		72.0 ± 10.1	
Second	2019 (n = 85)	95.7 ± 10.4	↑12.0%	70.0 ± 9.2	↑2.2%
	2020 (n = 107)	99.4 ± 5.1		84.4 ± 6.6	

3.2 Distribution of emergency medicine course results from 2015 to 2020

The comparison results of the CPR and final scores of the emergency medicine courses from 2015 to 2020 show that compared with the traditional stage, the proportion of students with a usual score of 80 or more in the first stage is higher, and so is the proportion of those with a final score of 70 or more. Compared with the first stage, the proportion of those with a score of 90 or more in the second stage is considerably higher, and the proportion of those with a score of 80 or more in the final stage is remarkably higher (Table 2, Fig. 1).

Table 2
Frequency distribution of the usual (CPR) and final results of emergency medicine course from 2015 to 2020

Phase	Years	Grades	0–59	60–69	70–79	80–89	90–100
Basic	2015 (n = 91)	usual	6 (6.6%)	53 (58.2%)	28 (30.8%)	4 (4.4%)	0
		final	3 (3.3%)	44 (48.3%)	39 (42.9%)	5 (5.5%)	0
	2016 (n = 94)	usual	12 (12.8%)	44 (46.8%)	35 (37.2%)	3 (3.2%)	0
		final	7 (7.4%)	26 (27.7%)	56 (59.6%)	5 (5.3%)	0
First	2017 (n = 92)	usual	3 (3.3%)	1 (1.1%)	5 (5.4%)	15 (16.3%)	68(73.9%)
		final	0	7 (7.6%)	38 (41.3%)	46 (50.0%)	1 (1.1%)
	2018 (n = 84)	usual	6 (7.1%)	3 (3.6%)	7 (8.3%)	42 (50.0%)	26 (31.0%)
		final	7 (8.3%)	30 (35.7%)	26 (31.0%)	18 (21.4%)	3 (3.6%)
Second	2019 (n = 85)	usual	1 (1.2%)	5 (5.9%)	1 (1.1%)	0	78 (91.8%)
		final	11 (13.0%)	24 (28.2%)	37 (43.5%)	13 (15.3%)	0
	2020 (n = 107)	usual	1 (0.9%)	0	0	1 (0.9%)	105 (98.2%)
		final	0	3 (2.8%)	20 (18.7%)	61 (57.0%)	23 (21.5%)

Discussion

4.1 Problems with traditional cardiopulmonary resuscitation courses

4.1.1 Disconnect between theory and practice

At present, medical education is a sequential process from theory to practice. Understanding the theoretical courses is very difficult for students lacking clinical practical experience. This situation is not uncommon in the continuing education of medical students after graduation. Junior doctors often encounter difficulty connecting theory with the clinic, and senior doctors face challenges in returning to theory with their habitual thinking.

Kolb proposed an experiential learning model in the 1980s. It consists of four parts[14]: practical experience, feedback observation, abstract concepts, and active attempts. The four parts are looped repeatedly to improve learners' theoretical and practical abilities. The essence of this model is to combine theory with practice through repeated cycles. The necessary condition is the learner's active observation, thinking, and experimentation. In a short period of 2 class hours (90 minutes), how to guide medical students without a basis in clinical practice to think actively is a difficult point for educators. In the course of CPR, we are faced with how to make students feel the images of clinical CPR in their minds and how to match these images with the required high-quality CPR techniques and various numbers.

4.1.2 Disconnect between teaching and learning

In traditional colleges and universities, teachers usually teach classes and midterm and final assessments, and the communication between teachers and students is very minimal. Especially in the teaching of various clinical subjects, teachers come from major hospitals, and each teacher is only responsible for his own theme. After the lecture, communication with the students is rare. Re-intersection occurs after the final assessment, and the teaching method is adjusted according to the answer; this is undoubtedly the disconnect between teaching and learning.

When teaching a large class with more than 100 people, how should attention be paid to the learning effect of the students, and how is feedback on the teaching effect made from the perspective of the students, that is, how to determine whether the students understand or not, this is a knowledge. When teaching CPR courses, students would be interested in actual clinical cases. Clinical cases can be used as a point of interest to guide students in obtaining a deeper understanding of how and why each step of CPR should be carried out, that is, let students know what is and why.

4.1.3 Disconnect between professional teaching and medical humanities

In teaching professional theory courses, following the text and simply discussing theoretical knowledge is easy. Everyone knows that ideological and political elements are an effective support for professional theory. Medical humanities teaches us to keep abreast of the latest educational theories and teaching concepts at all times, and always keep a clear head to deal with several problems that may arise during practice. For the education of students, the situation should be used, and students should be taught in accordance with their aptitude. Our education should be adjusted at any time to adapt to every student, rather than training students suitable for education.

The CPR course itself covers medical humanities elements. For patients who have died clinically, how we can actively rescue the individual while respecting the individual requires an in-depth discussion. The unity of knowledge and action is the starting point and goal of medical humanities. In the knowledge-action relationship, "knowledge" is the premise of "action," and "action" is the purpose of "knowledge." Without "knowing" but "doing," "doing" will lose its direction and easily go astray, but only "knowing" without "doing" will lose its meaning. CPR is not only a way to save people but also a decision made when facing life. Each point of CPR is very important. Any disconnection or slack in the link will bring the

price of blood. How to guide students to look at life reasonably in the short teaching time requires teachers to think deeply.

4.2 Teaching innovation of CPR course

Based on the thinking in the above teaching, combined with the close connection between the CPR course itself and clinical practice, we consider that based on the traditional teaching mode and content, we should be student centered and guided by teaching goals, apply heuristic teaching mode, introduce clinical practice cases, incorporate medical humanities elements, apply basic knowledge of medical physics and pathophysiology, and teach students how to understand the action essentials in the teaching content and assist various digital memories in CPR. The goal is to make students familiar with the course of CPR and achieve to know what it is and why it is so.

The results of this research show that after teaching innovation, students' usual grades and final grades are improved compared with traditional teaching. The teaching innovation of the CPR course improves the grades of the CPR course, enables students to apply learning methods to the overall curriculum of emergency medicine, and enhances the overall course of emergency medicine.

4.2.1 BOPPPS

The teaching model of BOPPPS[11] is applied and according to the teaching goals; students are gradually guided and mobilized to think actively, fundamentally understand the methods and connotations of CPR, and incorporate ideological elements.

4.2.1.1 Bridge-in

For students who have not yet entered clinical work, the CPR video is used as the basis for their perceptual understanding of CPR. The video covers the basic life support part of CPR. Through actual cases, the patient's performance in cardiac arrest, the reaction of the first witness, the method and steps of CPR, the application of defibrillator, and team cooperation are demonstrated for students to have an intuitive, perceptual understanding of CPR. Moreover, students are taught that the current situation of CPR is not optimistic, and its success rate is still very low. It requires everyone in society to contribute their own strength and use the knowledge they have learned to save lives.

4.2.1.2 Objective

The purpose of learning CPR, including course goals and goals of CPR, is clarified. Course objectives include mastering the diagnosis of cardiac arrest, CPR methods, procedures, and indications of successful resuscitation; familiarizing with the concepts of resuscitation complications, clinical death, and biological death; understanding the mechanism of CPR, the treatment of airway foreign body obstruction, and defibrillators; and guiding students to self-learn arrhythmia and post CPR management procedures, and CPR guideline update[15–19]. The goals of CPR are divided into primary goals and

ultimate goals. The primary goal is to restore spontaneous circulation, and the ultimate goal is to recover and return to society.

4.2.1.3 Preassessment

The pre-class test is not limited to the form. For large classes with limited time, the pretest part is not limited to the pre-course, but the interactive questioning method is used before each learning stage or key knowledge point is taught, which is helpful to understand the students. The basic cognition level can also allow students to think and listen to the class with questions, which is helpful to the understanding and application of knowledge in the future. For example, in the introduction, "What are the factors that can lead to cardiac arrest?" A seed can be planted in the students' hearts, they learn with this question, and wait until the answer is revealed, which can deepen their memory of knowledge points.

4.2.1.4 Participatory learning

Participatory learning methods, heuristic teaching, and in-depth layer by layer are applied to inspire students to use the knowledge they have learned to explore the connotation of CPR, guide students to find answers, and cultivate good learning and thinking methods. For example, the step of "chest compression" in CPR introduces pathophysiology to explain the mechanism and connotation of chest compression; the step "opening the airway" guides students to try their own airway opening and closing states to understand what the step is; the step "ventilation" introduces Poiseuille's law in fluid mechanics to explain the time and connotation required for ventilation based on the opening of the airway. In letting students be the implementers of the courses, not just the trainees, students acquire a deep understanding of the knowledge points, which is conducive to their future operation of skills courses and ultimately, clinical practice.

4.2.1.5 Post assessment

After the course, students are assessed based on their knowledge, and the teaching methods are adjusted according to the test results. During the short teaching period, applicants take a small test in class, set up questions for students according to the key questions of the syllabus, set up open questions appropriately, and are encouraged to think independently.

4.2.1.6 Summary

Finally, the course as a whole is summarized, the teaching focus is reiterated, students are guided to review the main points of the course, the learning content is expanded, and students are provided space for self-study. The guiding process is carried out by asking questions, guiding students to review the entire course by themselves and find blind spots again. Summary is a very important part of the course, which helps students obtain a clearer understanding of the course as a whole.

4.2.2 PAL teaching methods

The PAL teaching method is adopted[12, 20], the coat of teachers is taken off, CPR-related knowledge is discussed with students in the attitude of pioneer partners in the same field[21], students are encouraged to raise objections, and practical clinical issues are discussed with one another, which will help deepen the understanding and memory of knowledge points[22].

For example, when teaching the ECG performance during cardiac arrest, the ECG evolution of cardiac arrest cases seen in the clinic are shared with the students. Students can participate in the discussion and learn what they need as if they were talking. Bringing in such a situation makes students have a firmer grasp of knowledge points.

4.2.3 Medical humanities methods

Medical humanities brings more space to teachers and students. While teaching theoretical knowledge, more attention is paid to thoughts and thinking. As the saying goes, “With copper as a mirror, you can straighten your clothes; with ancient times as a mirror, you can know the rise and fall; and with people as a mirror, you can understand gains and losses.” Professional theoretical knowledge is to give fish to people, whereas the education we need is to teach people how to fish.

The course of CPR has its own medical humanities characteristics, ranging from the ethics of resuscitation to the idea of “preventing disease” in Chinese medicine, the understanding of pathophysiology-oriented CPR mechanism, and the dialectical materialism of individualized medicine. As medical teachers, we should lead the students on the correct path from the perspective of humanity and morality.

Conclusions

Overall, our CPR course teaching innovation is student centered and teaching goal oriented. It applies heuristic teaching mode, introduces BOPPPS teaching model and peer-assisted learning teaching methods, integrates medical humanities elements, and improves teaching quality of CPR courses in medical colleges.

Abbreviations

CPR cardiopulmonary resuscitation

BOPPPS bridge-in, learning objective, pretest, participatory learning, posttest, and summary

PAL peer-assisted learning

Declarations

- **Ethics approval and consent to participate**
Not applicable

- **Consent for publication**
Not applicable
- **Availability of data and materials**
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.
- **Competing interests**
The authors declare that they have no competing interests.
- **Funding**
Not applicable
- **Authors' contributions**
CL contributed to the conception of the study, and was a major contributor in writing the manuscript. ST performed the data analyses. YC helped perform the analysis with constructive discussions. All authors read and approved the final manuscript.
- **Acknowledgements**
Not applicable

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Figures

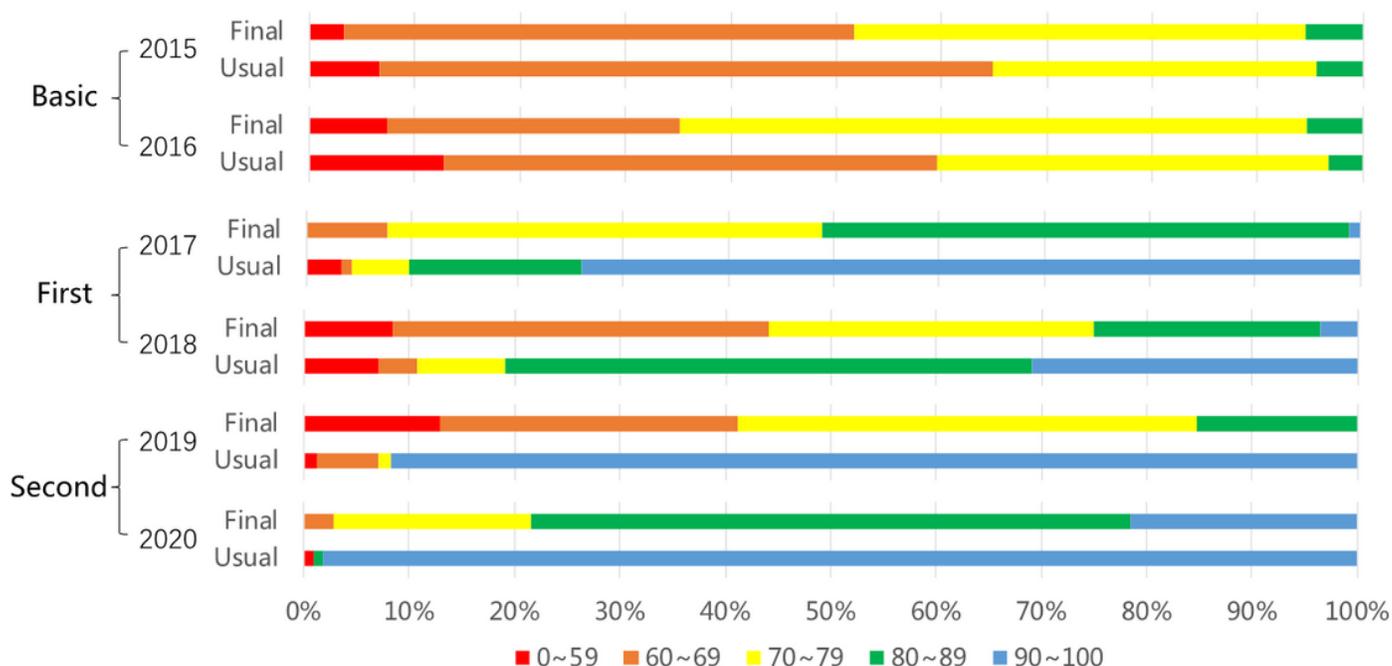


Figure 1

Distribution of performance in emergency medicine courses from 2015 to 2020.