

# Application of virtual scenario simulation combined with problem-based learning for paediatric medical students

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## Abstract

**Objectives:** To examine the application and effects of virtual scenario simulation combined with problem-based learning (PBL) in teaching paediatric medical students.

**Methods:** Participants were 300 paediatric medical students randomly divided into a study group and control group. Students in the study group were taught using virtual scenario simulation combined with PBL; students in the control group were taught using conventional teaching methods. Academic performance, knowledge of paediatrics, self-evaluation of comprehensive ability and degree of learning satisfaction were evaluated.

**Results:** Students in the study group showed considerably higher academic performance and noticeably higher classroom performance. Paediatric knowledge, comprising initiating communication, collecting information, giving information, understanding the paediatric patient and concluding communication, was higher for students in the study group. The degree of learning satisfaction was higher for students in the study group.

**Conclusion:** Virtual scenario simulation combined with PBL can effectively improve students' academic performance, mastery of paediatric knowledge, comprehensive ability evaluation and learning satisfaction. The broader application of this approach should be explored for medical student education.

## Keywords

Paediatric, virtual scenario simulation, problem-based learning, teaching, clinical thinking ability, medical education

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## Introduction

The quality of medical teaching affects patient health and safety, and the training of paediatricians affects the health of the next generation. At present, the teaching of paediatric medicine in China mainly focuses on cases or diseases explicated by teachers. This method is limited by weak goals and a low learning effect. Problem-based learning (PBL) is a student-focused method based on specific problems. This method aims to encourage students to study a problem using group discussion and under teacher guidance.<sup>1,2</sup> The virtual scenario simulation teaching method is a practical training method in which students adopt roles to simulate a specific working scene; the teacher analyses and guides their responses. This method is combined with group discussion and summary.<sup>3</sup>

The study aim was to explore the application and effect of virtual scenario simulation combined with PBL in paediatric teaching. It was hoped that the findings would help to improve paediatric learning effectiveness, optimize communication skills and provide some simulation of clinical practice.

## Materials and methods

### Subjects

Paediatric medical students in our hospital were selected as study subjects. These students were randomly divided into a study group and a control group using a random number table. The ethics committee of our hospital approved the present study and all participants provided written informed consent.

### Inclusion and exclusion criteria

The inclusion criteria were (1) students enrolled in paediatrics; (2) students who were  $\geq 18$  years old; (3) students who

voluntarily participated in the study. The exclusion criteria were (1) students with physical problems that prevented them from participating in the whole study; (2) students who had participated in similar teaching research.

### Study methods

Students in the control group received routine teaching. Specifically, basic medical paediatric education was taught according to the teaching syllabus. Students were guided and taught by doctors with extensive clinical experience.

A virtual scenario simulation combined with PBL teaching was used for students in the study group. The PBL teaching group comprised three to four teachers with extensive clinical work experience and high work capability. Teachers set the PBL teaching aims to ensure that students understood the characteristics of paediatric patients, clinical symptoms, other basic knowledge and the dosage and methods of common paediatric drugs. Teachers gave each student a copy of the admission goal, explained common problems experienced by students, consolidated students' specialized knowledge and strengthened their operational skills. Each teacher arranged for objective feedback evaluation to be carried out once a week. At the end of the virtual scenario simulation, students discussed the advantages and disadvantages of the virtual process and made suggestions for improvement under the guidance of the teacher. The control group received education via the conventional teaching method.

### Evaluation indicators

1. Performance appraisal: To evaluate the learning achievements of both groups after 2 months, paediatric teachers used a self-devised examination of teaching effects. This comprised theoretical

- knowledge and practical skills, case analysis and classroom performance (including attendance). Speech situations were used to evaluate and discuss scoring, theoretical knowledge and practical skills. Points were allocated out of 100 for theoretical knowledge, practical skills and case analysis. There was a maximum of 25 points for classroom performance. A high student score indicated excellent performance. This scale showed good internal consistency (Cronbach's alpha: 0.830) and test-retest reliability (0.813).
2. Paediatric communication skills: A doctor-patient communication skills evaluation scale, the Set the stage, Elicit information, Give information, Understand the patient's perspective, and End the encounter [SEGUE]<sup>4</sup> was used to evaluate students' communication skills. The five SEGUE dimensions were evaluated as follows: initiating communication (five items; yes = 2 points, no = 1 point), collecting information (10 items; yes = 2 points, no = 1 point, cannot answer = 0 points), giving information (four items; yes = 2 points, no = 1 point, cannot answer = 0 points), understanding of the child (four items; yes = 2 points, no = 1 point, cannot answer = 0 points) and ending communication (two items; yes = 2 points, no = 1 point). Higher student scores demonstrated better communication skills.
  3. Self-evaluation of comprehensive ability: A self-devised assessment scale was used to evaluate students' learning, cooperation, clinical thinking, communication skills, problem solving and other abilities. The total possible score was 100. Students were evaluated at the beginning of the study and again at the end of the study. A significant improvement in students' performance was indicated by a score increase of  $\geq 15$ ; a lack of improvement was indicated by a score increase of  $< 15$ . This scale showed good internal

consistency (Cronbach's alpha: 0.830) and test-retest reliability (0.813).

4. Study satisfaction: The study satisfaction of the two student groups was investigated using a self-devised hospital satisfaction questionnaire. The total possible score was 60; scores  $> 55$  indicated very satisfied, scores 40 to 55 indicated satisfied, scores  $< 40$  indicated not satisfied. A total satisfaction score was obtained by combining 'very satisfied' and 'satisfied' responses: satisfaction = (very satisfied + satisfied)/total number of people \* 100%. This scale showed good internal consistency (Cronbach's alpha: 0.830) and test-retest reliability (0.813).

### Statistical analysis

All data were collected, verified and collated by professionals. IBM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, NY, USA) was used for data processing. The measurement data were expressed as mean  $\pm$  standard deviation, and count data presented as percentages (%). The Shapiro-Wilk  $W$  test was used to test normality and the  $F$ -test was used to test for homogeneity of variance. The  $t$ -test was used for comparisons between the two groups. A nonparametric test was used to compare the mean values of various samples that did not obey the normal distribution or obeyed the normal distribution but had different variances. The chi-square test was used for count data.  $P < 0.05$  was considered statistically significant.

## Results

### General data

A total of 300 paediatric medical students were included in the present study. Of these, 130 were men and 170 were women. Their ages ranged from 22 to 25 years. There were 150 students in the study group: 70 men and

80 women. Their ages ranged from 22 to 25 years. There were 150 students in the control group: 60 men and 90 women. Their ages ranged from 22 to 25 years. There was no significant difference in age, gender or other general characteristics between the two groups. Thus, data were comparable between the two groups.

### *Between-group comparison of academic and classroom performance*

As shown in Table 1, academic performance, which comprised theoretical knowledge, practical skills and case analysis, were considerably higher in the study group than in the control group, and the difference was statistically significant ( $P < 0.05$ ). Performance in class, which comprised rate of attendance, speech in class and discussion time, were noticeably higher in the study group than in the control group,

and the difference was statistically significant (all  $P < 0.05$ ).

### *Between-group comparison of knowledge of paediatrics*

Students' mastery of paediatrics, which comprised initiating communication, collecting information, giving information, understanding of paediatric patients and concluding communication, was noticeably better in the study group than in the control group, and the difference was statistically significant (all  $P < 0.05$ , Table 1).

### *Between-group comparison of self-evaluation of comprehensive ability*

The self-evaluation of comprehensive ability, which comprised cooperative ability, clinical thinking, communication skills and problem-solving ability, substantially improved in the study group compared

**Table 1.** Between-group comparison of academic and classroom performance and knowledge of paediatrics.

Items	Control group (n = 150)	Study group (n = 150)	t value	P
<b>Academic and classroom performance</b>				
<b>Academic performance</b>				
Theoretical knowledge	78.62 ± 10.65	92.68 ± 9.01	12.344	<0.001*
Practical skills	73.54 ± 12.29	93.52 ± 8.78	16.201	<0.001*
Case analysis	75.92 ± 11.16	94.93 ± 7.82	17.085	<0.001*
<b>Classroom performance</b>				
Rate of attendance	10.24 ± 1.35	16.52 ± 1.62	36.473	<0.001*
Speech in class time	10.82 ± 1.89	18.73 ± 1.49	40.385	<0.001*
Discussion time	11.04 ± 1.73	18.38 ± 1.64	37.711	<0.001*
<b>Knowledge of paediatrics</b>				
Initiating communication	6.61 ± 0.63	8.52 ± 0.43	30.668	<0.001*
Collecting information	9.32 ± 1.03	15.01 ± 1.28	42.416	<0.001*
Giving information	4.21 ± 0.69	6.64 ± 0.53	34.206	<0.001*
Understanding paediatric patients	4.41 ± 0.52	6.69 ± 0.38	43.357	<0.001*
Ending communication	2.41 ± 0.24	3.63 ± 0.32	37.355	<0.001*

\* $P < 0.05$ .

with the control group. The difference was statistically significant ( $P < 0.05$ , Table 2).

### Between-group comparison of learning satisfaction

The degree of learning satisfaction was clearly higher in the study group than in the control group, and the difference was statistically significant (all  $P < 0.05$ , Table 2).

## Discussion

The results of this study showed that students' academic performance, classroom performance, mastery of paediatric knowledge, self-evaluation of comprehensive ability and learning satisfaction were significantly higher in the study group than in the control group.

Paediatric teaching is a unique medical subject. Paediatricians not only treat patients whose self-expression ability is not yet fully developed, but also provide care to anxious parents.<sup>5,6</sup> Effective communication between doctors and patients can substantially reduce the risk of hospital disputes and improve the efficiency and

treatment effect for paediatric patients. Medical students should pay attention not only to theoretical knowledge in class but also practical application ability and communication ability. Conventional teaching methods are teacher-focused, supplemented by textbooks and handouts; students have a lower degree of participation in these methods. A previous study showed that a combination of virtual scenario simulations with PBL teaching can both enable the teaching of theoretical knowledge and help students who perform poorly with conventional teaching methods.<sup>7-10</sup> PBL teaching aims to provide effective solutions to problem orientation.<sup>11-14</sup> Virtual scenario simulation teaching can enable students to actively participate in teaching and improve their ability to adapt to clinical practice. These teaching methods supplement each other and are effective in improving the teaching quality of medical students in paediatrics.<sup>15-17</sup>

The present findings showed that students in the study group scored significantly higher on academic performance (theoretical knowledge, practical skills and case analysis). This suggests that a combination

**Table 2.** Between-group comparison of self-evaluation of comprehensive ability and learning satisfaction.

Items	Efficacy	Control group (n = 150)	Study group (n = 150)	$\chi^2/t$	P
Self-evaluation of comprehensive ability					
Cooperative ability	Substantially improved	102	140	30.863	<0.001*
	Not improved	48	10		
Clinical thinking	Substantially improved	129	142	6.451	0.011*
	Not improved	21	8		
Communication skills	Substantially improved	98	139	33.776	<0.001*
	Not improved	52	11		
Problem-solving ability	Substantially improved	112	146	32.004	<0.001*
	Not improved	38	4		
Learning satisfaction					
Satisfaction	Very satisfied	84	132	29.67	<0.001*
	Satisfied	39	28		
Non-satisfaction		27	0		

\* $P < 0.05$ .

of virtual scenario simulation and PBL teaching can effectively improve students' academic performance and theoretical and practical skills. Class performance (attendance rate, speech in class and discussion times) was significantly higher in students in the study group than in the control group. This indicates that a combination of virtual scenario simulation and PBL teaching can effectively mobilize students' learning enthusiasm and sense of participation in classes, help them to learn actively and improve the learning effect. Students' mastery of paediatric knowledge (initiating communication, collecting information, giving information, understanding paediatric patients and concluding communication) was significantly better in the study group than in the control group. This indicates that virtual scenario simulation teaching combined with PBL is conducive to the efficient and complete mastery of knowledge, the communication ability of students in class and the development of communication skills. The self-evaluation of comprehensive ability (cooperative ability, clinical thinking, communication skills and problem-solving ability) considerably improved in the study group when compared with the control group, and the difference was significant. This indicates that virtual scenario simulation combined with PBL teaching can give students a clear sense of their own growth and gain, and improve their enthusiasm for learning. The degree of learning satisfaction was noticeably and significantly higher in the study group than in the control group. This suggests that the virtual scenario simulation combined with the PBL teaching method can effectively improve student satisfaction with learning. The main limitation of this study is that we did not evaluate students studying other majors. This could be rectified in the future.

## Conclusion

The virtual scenario simulation combined with PBL teaching can effectively improve students' academic performance, mastery of paediatric knowledge, self-evaluation of comprehensive ability and learning satisfaction. This method should be more widely applied in teaching medical students.


## Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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