

Analysis of the Application Value of Virtual Reality Combined with Flipped Classroom Teaching Mode in Cardiopulmonary Resuscitation Teaching

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Abstract: *Objective:* To analyze the value of using virtual reality combined with the flipped classroom teaching model in teaching cardiopulmonary resuscitation (CPR). *Methods:* Two classes of our nursing program were randomly selected for the study from September 2022 to September 2023, Class A (52 students, conventional teaching method) and Class B (52 students, virtual reality combined with flipped classroom teaching mode). The assessment scores and independent learning ability scores of the students in the two classes were compared. *Results:* CPR theory and operation scores, passing rate, and independent learning ability scores of Class B were higher than those of Class A ($P < 0.05$). *Conclusion:* the use of virtual reality combined with the flipped classroom teaching mode in CPR teaching is conducive to the improvement of students' assessment scores and independent learning ability.

Keywords: Virtual reality; Flipped classroom teaching mode; Cardiopulmonary resuscitation; Assessment performance; Independent learning ability

Online publication: June 6, 2024

1. Introduction

Influenced by many factors such as aging aggravation, the number of patients with sudden cardiac arrest (SCA) in clinical consultations has been increasing year by year, and clinical research data show that 544,000 patients with SCA are also consulted nationwide every year, but the unpredictable time and place of SCA patients' illnesses and the lack of public knowledge and skills of first aid result in the deaths of many patients with SCA^[1,2]. Cardiopulmonary resuscitation (CPR) is an effective measure to save SCA patients, but one of the major challenges facing the field of emergency medicine is how to perform CPR for SCA patients as early as possible^[3]. In recent years, the government of China has been popularizing CPR-related knowledge and skills to the public through various ways to improve the public's ability to provide first aid to SCA patients and reduce the mortality rate of SCA. Medical students must have knowledge and skills related to CPR, so every emergency teaching physician is committed to exploring methods to improve the quality of emergency CPR teaching^[4]. Conventional teaching methods are generally poor due to the single, dull teaching method, which

makes it difficult to stimulate students' learning initiative, resulting in generally poor teaching quality. Virtual reality combined with the flipped classroom teaching mode used in CPR teaching can stimulate students' learning enthusiasm and improve their independent learning ability^[5]. This study analyzes the value of using virtual reality combined with flipped classroom teaching mode in CPR teaching, as described below.

2. General information and methods

2.1. General information

Two classes in the nursing program of our hospital were randomly selected for the study from September 2022 to September 2023. Class A (52 cases) had 12 males and 40 females, aged 19–24 (21.34 ± 0.86) years old, theoretical and operative scores before participating in the study were 72.23 ± 3.57 and 72.86 ± 3.67 respectively. Class B (52 cases) had 12 males and 40 females, aged 20–23 (21.18 ± 0.84) years old, theoretical and operational scores were 72.86 ± 3.59 and 72.52 ± 3.65 respectively before participating in the study. The general information of both groups was comparable ($P > 0.05$).

2.2. Methods

2.2.1. Class A

Class A adopted the conventional teaching method. Teachers explained CPR-related knowledge and demonstrated the CPR operation process in the classroom, students simulated and practiced CPR operation skills in groups, and teachers corrected students' wrong behaviors and went to the training room to practice the CPR operation process during the open hours of the training room. After class, students learned CPR-related knowledge and operation videos on the school learning platform.

2.2.2. Class B

Class B adopted virtual reality combined with flipped classroom teaching mode.

- (1) Before the class: One week before the CPR teaching, the information and videos about the knowledge and operation process of CPR filmed and collected by the teacher were posted on the school's learning platform, and students were asked to make use of their class time to prepare for the class. Teachers shared the relevant contents of the virtual reality combined with the flipped classroom teaching mode in the class's WeChat group for learning, and divided the class into groups, with the teacher and the students exchanging previews and problems encountered during the process of preparing in the WeChat group at any time. Students completed the preview tasks within the time required by the teacher. According to their own preferences, the students chose the simulation scenes they were interested in in the VR (virtual reality) glasses of the interactive virtual reality equipment and practice the CPR resuscitation process independently in simulation. Before students practiced the VR simulation using the VR glasses, they first discussed the CPR operation process and precautions with group members. For example, the VR simulation scene was chosen: the patient suddenly collapsed to the ground, medical personnel immediately performed rescue actions, the patient's consciousness and breathing were determined, starting to call for help, performing chest compressions, opening the airway and blowing, and the effective indications was judged after five consecutive cycles. VR simulation scene has a high degree of simulation, and if the students performed improper steps in the resuscitation process, they cannot carry on the next link of the practice, suggesting that the rescue failed. Students practiced the resuscitation scenarios repeatedly with VR glasses until all the

resuscitation steps were completed accurately and successfully, prompting a successful resuscitation. In this period, the teacher completed the pre-course preparation work, designed the content of the flipped classroom, and took the common problems appearing in the pre-course preparation process of the students statistically by the system as key problems in the classroom.

- (2) During the class: The classroom teaching was within the scope of the six links as described below.
 - (a) Brainstorming: Each group summarized the problems encountered in the pre-study and each group member shared the learning experience. After the discussion, the leader of each group stated the problems encountered by the group, the teacher answered each question and guided the students to summarize the summary, the teacher affirmed the effect of students' pre-study in the process.
 - (b) Explanation of key points: Teachers focused on explaining the common problems encountered by students in the pre-preparation process, such as how to ensure effective frequency and depth of compression, how to quickly open the airway, how to improve the success rate of resuscitation, and so on.
 - (c) Operational demonstration—flipped classroom session: Two students explained and demonstrated the CPR operation process, one student demonstrated the steps of resuscitation in the interactive advanced simulation simulator while one student explained. After the demonstration, the teacher commented and pointed out the improper operation.
 - (d) Operation practice: The interactive advanced simulation simulator for operation practice was used in a group unit, and the teacher guided every group.
 - (e) Simulation assessment: The teacher assessed the group leader's simulation operation, and those with excellent assessment results assessed the group members one by one. After all the groups had completed the assessment, the teacher randomly selected a student to demonstrate the CPR operation process and evaluated the students' mastery of CPR resuscitation skills and teaching effect.
 - (f) Classroom teaching summary: The teacher summarized at last and taught the students the key and difficult content mnemonics.
- (3) After the class: Teachers released the review content on the learning platform, assigned students tasks such as practicing operations and recording videos, and let students upload their post-class assignments to the platform and teachers commented on them one by one. Teachers used the background of the system to understand the situation of each student's homework, and if the students did not pass the test, they were individually instructed and set up personalized practice tasks.

2.3. Observation indicators

2.3.1. Examination results

Statistics on students' CPR theory and operation scores and pass rate.

2.3.2. Autonomous learning ability score

Using the independent learning ability scale to assess students' independent learning ability from four dimensions of learning motivation, self-management ability, cooperation ability, information literacy, and so on by Likert 5-point scoring method; learning motivation had 8 entries, self-management ability had 11 entries, cooperation ability had 5 entries, information literacy had 6 entries, and the scores were positively correlated with the independent learning ability.

2.4. Statistical analysis

SPSS25.0 was used to process the data, and the measurement and count data were expressed as mean \pm standard deviation (SD) and %, and the t value and χ^2 test were used respectively, and $P < 0.05$ indicated statistically significant difference.

3. Results

3.1. Comparison of test scores

Class B's CPR theory and operation scores and passing rate were higher than that of Class A ($P < 0.05$), as shown in **Table 1**.

Table 1 Comparison examination results (mean \pm SD, n)

Group	Number of cases	Theoretical exam			Operational test		
		Score (points)	Pass	Passing rate (%)	Score (points)	Pass	Passing rate (%)
Class B	52	85.34 \pm 6.37	49	94.23	86.92 \pm 6.58	46	88.46
Class A	52	77.28 \pm 4.12	39	75.00	78.64 \pm 4.68	35	67.30
χ^2/t	-	7.661	-	7.386	7.394	-	6.754
P	-	0.000	-	0.006	0.000	-	0.009

3.2. Comparison of independent learning ability scores

The independent learning ability score of Class B was higher than that of Class A ($P < 0.05$), as presented in **Table 2**.

Table 2. Comparison of independent learning ability scores (mean \pm SD, points)

Group	Number of cases	Learning motivation	Self-management skills	Cooperation skills	Information literacy
Class B	52	89.36 \pm 4.34	87.68 \pm 5.26	88.94 \pm 4.81	89.58 \pm 5.37
Class A	52	76.29 \pm 5.34	75.98 \pm 4.64	76.53 \pm 4.67	76.34 \pm 5.06
t	-	13.696	12.028	13.348	12.939
P	-	0.000	0.000	0.000	0.000

4. Discussion

CPR is the most commonly used and effective first aid operative technique that requires high hands-on ability to save patients' lives, and all nursing students must master CPR-related knowledge and skills [6]. In the conventional teaching method used in the past, teachers act as the main body of teaching and learning, who first instill CPR-related knowledge, demonstrate the CPR operation process to the students in the classroom, and then divide the students into several groups to practice the CPR skills; the students passively learn the knowledge in the classroom and lack the initiative to learn, which leads to unsatisfactory overall learning effect of students [6]. In order to improve students' motivation to learn CPR-related knowledge and skills as well as the learning effect, our institute introduces virtual reality combined with flipped classroom teaching mode with diverse, multi-dimensional, and multi-level characteristics, which has the advantages of active learning, personalized learning, scientific learning, mobile learning; the learning main body is shifted from the teacher to the students, and the teacher becomes the instructor who teaches the course content and the facilitator who

prompts the students to learn ^[7,8].

The theory and operation scores of CPR, passing rate, and independent learning ability scores of Class B were higher than those of Class A ($P < 0.05$), confirming that the use of virtual reality combined with the flipped classroom teaching mode in CPR can improve the quality of teaching. The results of a study by Wang *et al.* showed that the use of virtual reality combined with flipped classroom teaching mode in CPR teaching can effectively improve students' independent learning ability, teaching satisfaction, and teaching effect, which is consistent with the results of this paper. Virtual reality combined with the flipped classroom teaching mode will change the teaching subject to students, students are in the leading position in classroom teaching, and the teacher becomes the organizer and guide of classroom teaching playing the main role of guiding the students to actively learn the relevant knowledge, and cultivate students' independent learning ability. Teachers use virtual reality combined with flipped classroom teaching mode in CPR teaching, and provide students with personalized and systematic teaching materials, videos, and other materials on the school's teaching platform before class, giving full play to the advantages of modern teaching methods that are convenient and efficient, and breaking the time and space constraints of students' learning ^[9]. Students take the initiative to watch the videos and materials on the teaching platform before class, and actively look for the answers to the questions posed by the teacher, so as to promote the development of critical and analytical thinking. Teachers in the classroom use a variety of ways (open teaching platform, group operation, group discussion, etc.) to enliven the classroom atmosphere, so that students learn in a relaxed and pleasant classroom environment, and to improve the interaction between teachers and students, students and students, so as to increase students' satisfaction with the teaching methods ^[10]. Teachers guide students to discuss problems in groups in the classroom, which not only improves students' interest in learning, but also improves their ability to find and solve problems, stimulates their interest in learning CPR, prompts them to take the initiative to deeply understand and explore CPR-related knowledge and skills, and improves their ability to think and learn actively. Lastly, teachers guide students to summarize CPR knowledge and improve their clinical practice skills ^[11]. In addition, teachers reflect on their own teaching process after class, discover problems in teaching in a timely manner, and take effective measures to solve them, which is conducive to the improvement of teaching quality. However, in the course of this study, it was found that a small number of students rejected the virtual reality combined with flipped classroom teaching mode and thought that they needed to spend a lot of time to find relevant information for self-study after class, and their learning burden increased significantly ^[12]. Therefore, it is necessary to further optimize the virtual reality combined with flipped classroom teaching mode, using different teaching methods to cultivate students at different levels, prompting more students to actively participate in learning, so as to cultivate more high-quality nursing talents for the clinic.

5. Conclusion

In summary, the use of virtual reality combined with flipped classroom teaching mode in CPR is conducive to improving students' assessment results and independent learning ability.

Disclosure statement

The author declares no conflict of interest.

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