Journal of Contemporary Educational Research, 2025, Volume 9, Issue 10
http://ojs.bbwpublisher.com/index.php/JCER
ISSN Online: 2208-8474
ISSN Print: 2208-8466

Integration of Problem-Based Learning and Case-Based Learning in Chinese Endodontics Standard Resident Training

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Abstract: As the most critical part of post-graduate education, the Chinese government launched Standard Resident Training in 2013 to solve the regional inequality of medical quality and meet the increasing social requirement for better medical service. We integrated problem-based learning (PBL) and case-based learning (CBL) in the Endodontics Standard Resident Training. By evaluating with objective parameters including theoretical knowledge and clinical practice skill, and subjective parameters including questionnaire, it was found that PBL+CBL played a positive role in endodontic resident training with a significant difference ($P < 0.05$). This combined training model is instructive for China's resident training, and this result can provide a rudimentary reference to current postgraduate teaching reform.

Keywords: Problem-based learning; Case-based learning; Postgraduate education; Standard Resident Training; Endodontics

Online publication: November 11, 2025

1. Introduction

China currently has the world's highest population and is one of the rapidly aging nations worldwide. By 2029, nearly 25% of China's population will reach over age 65, peaking at 0.36 billion [1]. In the coming years, this increasing and aging population will significantly burden the demand for dental care on the existing overloaded system, especially in Endodontics, which focuses on the treatment of highly prevalent infectious oral diseases, such as caries and pulp diseases. According to the report from the Chinese Stomatological Association (CSA), there are 314,347 oral medical professionals in China, including 171,587 (54.6%) dentists. The ratio of dentists to population is 1:7,769, lower than the WHO's standard of 1:5,000 [2,3]. Unlike prevention-oriented dental care in many developed countries, the motivation for seeking oral health care in China is mostly driven by pain suffering induced by diseases. Other than individual awareness, the lack of professionals in China also

results in a dental care shortage [4]. Moreover, it is also worsened by the insufficient resources of medical care and professional training resulting from regional development inequity, particularly in the underdeveloped rural areas. In order to address this problem, standardizing the quality of Chinese medical service was jointly launched by the National Health and Family Planning Commission of China and other six government ministries, which is known as the Standardized Resident Training (SRT) program in 2013, including the dental resident training, aiming to enforce the practical ability and emphasize the transition from dental student to competent dental care provider [5]. Endodontics is a basic and critical branch of dental medicine which not only related to the most common oral infectious diseases, including caries, pulp, and apical periodontal diseases, but also is a practical discipline due to its fine manipulation, strong clinical logic, and close relationship with other dental specialties. Therefore, improving the teaching quality to better cultivate competent dental care providers with good endodontic professional ethics and clinical skills is the goal of our Endodontics resident training base [6]. In this study, we integrate case-based learning (CBL) and problem-based learning (PBL) teaching methods in Endodontic resident training to explore their effects on resident training quality.

2. Subjects and methods

2.1. Subject selection

Seventy-two residents (mean age of 25.14 ± 1.36) in their first-year rotation for three months in the Endodontic Department of Stomatological Hospital of Chongqing Medical University, from May 2018 to July 2019, were enrolled in our research. All residents were randomly divided into two groups, and informed consent was taken from all the subjects. In the study group, there were 12 males and 24 females aged 23 to 29 with an average age of 25.14 ± 1.36. The study group included five residents enrolled after graduating from dental school with a bachelor's degree, 26 residents enrolled as stomatology graduate students in the study, and five residents enrolled as clinic practitioners assigned by the working unit for advanced training. While in the control group, there were 11 males and 25 females aged 23 to 28 with an average age of 25.42 ± 1.05. The number of residents of the same three types as the study group was 4, 27, and 5, respectively. In both groups, every six residents were gathered in a small group for discussion.

2.2. Teaching method

CBL+PBL was conducted for the study group, while the control group was taught by traditional lecture-based learning (LBL) on the same topic. Teachers for the two groups remained the same and were trained in both CBL+PBL and LBL. At the end of CBL+PBL and LBL sessions, the two groups' performance was evaluated by a theoretical test and clinical skills evaluation, with the ratio of 60% and 40% accounting for the final score separately. Furthermore, the questionnaire was conducted to evaluate the feedback on the effect of CBL+PBL and LBL teaching methods on resident training.

2.3. Data analysis

The *t*-test was applied to see the difference in performance among the two groups, and χ^2 test was applied for analysis of the difference between the two teaching methods on the training efficiency separately. All data analysis was processed by SPSS 26.0, and $P < 0.05$ was considered significant.

3. Results

3.1. Test scores

As shown in **Table 1**, the mean score of the residents in the study group was significantly higher than that in the control group, including the theoretical knowledge test ($P < 0.05$).

Table 1. Mean score comparison between the two groups

	n	Theoretical knowledge test	Clinical skills test	Final score
CBL+PBL	36	84.67 ± 2.90*	92.10 ± 2.47	87.63 ± 2.11*
LBL	36	76.06 ± 4.11	88.87 ± 3.43	81.26 ± 3.13

*$P < 0.05$

3.2. Questionnaire analysis

The feedback on satisfaction with teaching methods from all residents is shown in **Table 2**. The combination of CBL and PBL was thought to have better effects, especially in aspects of study interest stimulation, critical thinking cultivation, and self-study motivation ($P < 0.05$).

Table 2. The result of the questionnaire feedback

Evaluation content	Study group	Control group
Study interest stimulation	31*	17
Critical thinking cultivation	32*	19
Self-study motivation	30*	20
Problem-solving ability	29	23
Teaching methods prefer	33*	21

*$P < 0.05$

4. Discussion

Before 2013, medical knowledge and clinical skills mainly relied on the undergraduate medical education and the experience learned from the hospital during the internship, which means that higher-ranked colleges or hospitals usually offer more and better training opportunities. Thus, in turn, the gap in medical service quality and medical education quality between urban and underdeveloped rural areas becomes increasingly larger [7]. Besides, due to the lack of a standard guideline for medical training, there was a situation where the clinical knowledge and skills learned from different teachers might be different even in the same hospital. In order to solve this regional inequity and differences between teachers, and finally to improve the medical service, and better meet the demands of people for a high-quality life, the Chinese government launched the nationwide Standard Resident Training program (SRT) in 2013, and SRT will be mandatory for physicians applying for clinical work by 2020 [8]. According to the national SRT guideline, Endodontics serves as the most time-consuming rotation department in dental resident training because of its core role in oral medicine. As one of the most crucial foundation specialties in dental medicine, Endodontics is very much a brain game that requires brain-fingers coordination to develop a visual and feeling three-dimensional network due to its characteristics of invisible operations and the complexity of the root canal system. A better long-term prognosis for patients also requires doctors to build a clear clinical reasoning system, including etiological analysis, diagnosis

confirmation, treatment planning, and prognosis evaluation [9]. Based on these challenges, constructing an efficient teaching method suitable for endodontic resident training is vital to cultivate competent dentists who provide high-quality dental service. Unlike the LBL teacher-centered passive learning method, PBL and CBL focus on motivating active self-directed learning [10,11]. As the two main teaching methods in undergraduate medical education currently, the application of PBL+CBL in endodontics resident training is still in the initial stages. In our study, we integrated PBL and CBL into endodontics resident training and found that the academic performance of residents attending the PBL+CBL session was better than that in the LBL session, with a significant difference of $P < 0.05$, except for the clinical skill evaluation, which also showed better feedback in the combined model but without a significant difference. Further, residents' feedback on the novel clinical teaching method on training quality was obtained by conducting satisfactory and value surveys, which showed that the majority of residents' feedback about their PBL+CBL experiences was significantly positive, especially in aspects of study interest stimulation, self-study motivation, and critical thinking cultivation.

In the past twenty years, PBL and CBL have been widely used in medical education internationally because of their effectiveness in self-motivated learning and clinical critical thinking improvement [11,12]. Previous studies found that the integration of PBL and CBL played a positive role in applying basic science principles to clinical decision making and enhancement of reasoning, which is similar to our findings [13]. We consider that this results from three aspects. Firstly, the first year of residency is when residents start to apply their knowledge to real patients as dental practitioners. They need a bridge that bonds the medical knowledge and experience learned from undergraduate school with real clinical practice, which helps treat patients professionally. PBL, an instructional and learner-centered approach, empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a solution to a defined clinical problem [14]. Secondly, a competent dental care provider should also have good critical thinking skills and be familiar with good dental practice regulations. Resident training aims at enhancing students' critical thinking and problem-solving ability through various real patient cases. CBL places the learner in the role of decision-makers as they read through the cases, and enables learners to discuss together to come to a set of recommendations to real-world examples, promotes residents' self-directed learning by applying knowledge to clinical cases, constructs their own knowledge system, and strengthens multidisciplinary knowledge-based diagnosis reasoning skills [11,15,16]. Lastly, PBL and CBL provide an open and less stressful discussion environment in which residents can freely reflect on their reasoning through analysis and synthesis in group discussion. In this way, residents' development of conceptual knowledge is enhanced to a deeper level of understanding, and the application of their knowledge and experience is strengthened across diverse cases and contexts [17,18].

The study has some limitations, including sample size, not involving high-grade residents, and less objective measurement for process evaluation. Future studies should describe the implementation on all grades' residents using a more objective measure that evaluates the knowledge acquisition process and perhaps its impact on patient outcomes.

5. Conclusion

The integrated model proposed in resident training has the potential to improve critical thinking and problem-solving, thus facilitating the resident training. It is worth expanding in Endodontics resident training.

Funding

This study was supported by the Teaching Reform Project of Stomatology College of Chongqing Medical University (KQJ202215, KQJ202204) and the Teaching Reform Project of Chongqing Medical University (JY20220317).

Disclosure statement

The authors declare no conflict of interest.

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