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Application Research of Online and Offline Blended Teaching in Continuing Medical Education of Basic Medicine

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Abstract: *Objective*: In view of the practical pain points of in-hospital continuing medical education, this study aimed to explore the application value of online and offline blended teaching in basic medical training for medical staff, so as to solve the practical problems of low participation enthusiasm of trainees, difficulty in understanding abstract theories, and poor connection between theoretical learning and clinical practice in traditional centralized teaching. It provides implementable practical evidence for medical institutions to optimize the reform path of basic medical continuing education. *Methods*: A total of 40 on-the-job standardized training physicians and newly recruited clinical medical staff in our hospital were enrolled and divided into two groups via a parallel control design, with 20 cases in each group. The control group adopted the traditional in-hospital training mode of centralized offline lectures combined with on-site practical demonstration. Based on the in-hospital teaching conditions, the observation group constructed an integrated blended training system of *pre-class online preview, in-class offline intensive teaching and practical operation, and after-class online review and expansion* adapted to the disciplinary characteristics of basic medicine. After the training cycle, unified assessments and questionnaire surveys were conducted to compare the differences in theoretical and practical scores, autonomous learning ability, and training satisfaction between the two groups. *Results*: The observation group achieved significantly higher scores in theoretical assessment, clinical practical operation, and comprehensive evaluation, as well as higher scores in autonomous learning initiative, in-depth knowledge understanding, clinical critical thinking ability, and scientific research literacy. The overall training satisfaction was also remarkably improved, and all inter-group differences were statistically significant ($P<0.05$). *Conclusion*: The targeted blended teaching model can effectively compensate for the shortcomings of traditional in-hospital basic medical continuing education, substantially improve medical staff's theoretical mastery and standardization of clinical operation, and cultivate trainees' autonomous learning ability and clinical thinking capacity. Complying with the training requirements of lifelong learning and progressive ability improvement in continuing medical education, this model is suitable for regular promotion and application in medical institutions.

Keywords: Blended teaching; Basic medicine; Continuing medical education; Teaching reform; Standardized clinical training

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1. Introduction

Basic medicine covers core disciplines including human anatomy, physiology, pathology, biochemistry, and pharmacology. As a prerequisite core curriculum for clinical medical staff to consolidate professional foundations, construct clinical thinking, and standardize diagnosis and treatment operations, it occupies a pivotal position in the standardized training system for young in-hospital physicians [1]. From the perspective of clinical teaching practice, basic medicine is characterized by numerous and complex knowledge points, strong theoretical logic, and abstract microscopic mechanisms. For physicians undergoing standardized training and newly recruited medical staff with short working experience and limited clinical experience, simple classroom lectures fail to help them fully grasp core principles, easily leading to fragmented memory of knowledge points and superficial theoretical cognition [2]. The previous in-hospital continuing education of basic medicine mainly adopted offline cramming centralized teaching with a relatively fixed teaching mode. The lack of pre-class preview guidance and after-class consolidation and expansion resources, as well as the limited duration of a single practical training session, deprives trainees of opportunities for repeated practice, review, and error correction. Consequently, most trainees passively receive knowledge with weak awareness of active exploration and thinking, resulting in a disconnection between theory and practice, namely proficient theoretical mastery but non-standard clinical operation and poor transformation of theoretical knowledge in clinical scenarios [3]. Against the background of emerging medical education reform and quality improvement of continuing medical education, the traditional single offline centralized training model can no longer meet the hierarchical and lifelong learning needs of clinical medical staff for competency improvement [4]. Blended teaching based on information-based teaching platforms integrates the dual advantages of online fragmented autonomous learning and offline targeted teaching, breaking the temporal and spatial limitations of traditional teaching, and has been widely applied in the teaching reform of various medical courses [5]. Based on the actual situation of in-hospital training, this study optimized and constructed a closed-loop blended teaching process and verified its application effect in basic medical continuing education through a controlled trial, aiming to further improve the quality of in-hospital continuing medical education and provide practical support for the standardized training of clinical talents.

2. Materials and methods

2.1. Research subjects

A total of 40 on-the-job standardized training physicians and newly recruited clinical medical staff who participated in basic medical continuing education in the hospital from January to June 2025 were selected as research samples. They were divided into the observation group and the control group by parallel grouping, with 20 cases in each group. In the control group, there were 11 males and 9 females, aged 18–21 years, with an average age of (19.52±0.82) years. In the observation group, there were 10 males and 10 females, aged 18–22 years, with an average age of (19.58±0.89) years. All subjects participated in systematic basic medical continuing education for the first time without prior relevant learning experience, with good physical and mental status, and completed the whole process of theoretical learning, practical training, final assessment, and questionnaire survey. Baseline data, including age, gender composition, and pre-job basic evaluation scores, were comparable between the two groups, with no statistically significant differences ($P>0.05$).

2.1.1. Inclusion criteria

(1) On-the-job standardized training physicians and newly recruited clinical medical staff of the hospital;
(2) Participants who completed the whole process of basic medical theoretical and practical continuing education without long-term unexcused absence;
(3) Participants who fully understood the study content, voluntarily participated in the survey, and cooperated with data collection.

2.1.2. Exclusion criteria

(1) Medical staff with long-term further study, vacation, or secondment during the research period;
(2) Participants with accumulated absences of 3 times or more who failed to complete the full training process;
(3) Participants who did not finish online learning tasks, submitted invalid questionnaires, or had missing research data.

2.2. Teaching methods

2.2.1. Control group

The control group adopted the traditional in-hospital continuing medical education mode, carrying out standardized offline centralized teaching in accordance with the in-hospital basic medical training syllabus. Theoretical teaching was mainly based on teacher-led PPT explanation and centralized knowledge compilation, with only occasional random in-class questions and no unified pre-class preview arrangement. Practical training adopted centralized demonstration teaching: teachers uniformly demonstrated standardized operating procedures, and trainees observed, imitated, and practiced independently under routine roaming guidance of teachers. The training assessment consisted of a final closed-book theoretical examination and a unified practical assessment, without online preview, online Q&A, or after-class personalized expanded learning links. The whole training followed the traditional fixed in-hospital teaching process [6].

2.2.2. Observation group

On the basis of conventional in-hospital teaching, the observation group adopted the Chaoxing Learning Platform to construct a closed-loop blended training model of *online pre-class guidance, offline targeted in-class learning, online after-class review and expansion, and diversified process evaluation* in combination with the dual characteristics of abstract theory and practicality of basic medicine courses. This model realized in-depth integration of online fragmented autonomous learning, offline targeted teaching, and practical reinforcement. The detailed implementation process optimized for in-hospital teaching practice was as follows.

Online pre-class guidance. Three days before centralized offline teaching, teachers uploaded targeted, streamlined teaching courseware, key knowledge micro-lessons, logical mind maps, pre-class self-test question banks, and preview thinking questions based on the key and difficult points of current training. For abstract knowledge that is difficult to visualize, such as anatomical structures, physiological metabolism, and pathological evolution, 3D structural demonstration animations and dynamic videos of physiological mechanisms were provided to help trainees intuitively understand abstract theories. For highly theoretical content, including pharmacological mechanisms and pathological classification, simplified clinical scenario cases were matched to guide trainees to think in combination with clinical practice. Trainees completed previews and self-tests in their fragmented spare time, and the platform automatically recorded learning duration, task completion, and error data. Teachers accurately sorted out common difficult problems of trainees based on background learning data to support targeted intensive explanation and Q&A in offline classes. Meanwhile, an online discussion section was opened to encourage active communication of preview doubts and cultivate trainees' active thinking habits [7].

Offline targeted in-class learning. The traditional cramming teaching mode was abandoned, and hierarchical intensive explanation and targeted Q&A were carried out, focusing on difficult problems fed back from pre-class preview. Interactive teaching, such as group discussion and scenario analysis, was conducted, combined with real clinical cases and working scenarios, to guide trainees to sort out knowledge logic and establish associative thinking between basic theories and clinical practice. The practical training adopted a dual mode of *online virtual simulation preview + offline practical reinforcement training*. Trainees were familiar with standardized operating procedures and avoided common operational errors through the virtual simulation platform before class. In class, teachers disassembled core operating key points step by step and corrected non-standard operational details pertinently, making up for the shortcomings of traditional practical training such as short single training time, insufficient repeated practice, and inadequate individual guidance [8]. In-class quizzes, group achievement reports, and random questioning were interspersed to timely test phased training effects and improve classroom efficiency.

Online after-class review and expansion. After each training session, teachers pushed chapter knowledge summaries, cutting-edge clinical research cases, special consolidation question banks, and expanded literature resources via the platform to help trainees systematically sort out classroom knowledge and broaden their knowledge breadth. Special review tests and error-sorting tasks were released for key and difficult knowledge points. The platform generated error analysis reports through automatic correction, guiding trainees to accurately identify weak points and conduct targeted remediation. Regular after-class tasks such as case analysis and knowledge review summaries were assigned, with trainees submitting results online and teachers providing one-on-one comments and guidance to realize personalized tutoring. A regular online Q&A mechanism was established to timely answer trainees' after-class questions, form a closed-loop teaching system, and promote knowledge internalization and continuous improvement of clinical competence.

Construction of a diversified process assessment system. Breaking the traditional single final summative assessment model, an integrated online-offline comprehensive evaluation mechanism was established. The process assessment, accounting for 40% of the total score, included online preview quality, online homework completion, in-class interaction performance, practical training results, and phased test scores. The final unified closed-book examination and comprehensive practical assessment served as the summative assessment, accounting for 60% of the total score. The whole-process recording of trainees' learning status objectively reflected their real learning level, guiding trainees to attach importance to daily accumulation and avoid cramming for examinations and superficial knowledge mastery.

2.3. Observation indicators

(1) Training assessment scores: Unified closed-book theoretical examinations and standardized clinical practical assessments were conducted after the training cycle. Both tests were scored out of 100 points, and the comprehensive score was the average of the two scores to evaluate the overall training effect of

the two groups.

(2) Autonomous learning effect score: A self-designed in-hospital learning effect questionnaire was adopted for evaluation from four dimensions: autonomous learning initiative, in-depth knowledge understanding, clinical thinking improvement, and scientific research ability expansion, with 25 points for each dimension and a total score of 100 points. Higher scores indicated better learning effects.

(3) Training satisfaction: Anonymous questionnaire surveys were performed to divide trainees' training experience into three levels: very satisfied, satisfied, and dissatisfied. Training satisfaction rate = (number of very satisfied cases + number of satisfied cases)/total number of cases ×100%.

2.4. Statistical methods

All data in this study were sorted and analyzed using SPSS 26.0 statistical software. Measurement data were expressed as mean ± standard deviation, and an independent-samples t-test was used for inter-group comparison; count data were expressed as cases (percentage) [n(%)], and a x^2 test was used for inter-group comparison. The test level α was set at 0.05, and P<0.05 was considered statistically significant.

3. Results

3.1. Comparison of training assessment scores between the two groups

Unified assessment after training showed that the observation group had significantly higher theoretical scores, clinical practical scores, and comprehensive scores than the control group, with statistically significant inter-group differences (P<0.001) (**Table 1**).

Table 1. Comparison of training assessment scores of medical staff between the two groups (points, Mean ± SD)

Group	Number of cases	Theoretical score	Practical operation score	Comprehensive score
Observation group	20	85.28±4.22	88.06±3.92	86.68±3.54
Control group	20	78.30±5.10	80.50±4.78	79.36±4.22
t value	-	4.782	5.216	5.635
P value	-	<0.001	<0.001	<0.001

3.2. Comparison of autonomous learning effect scores between the two groups

Questionnaire survey results indicated that the observation group had significantly higher scores in the four dimensions of autonomous learning initiative, knowledge understanding depth, clinical thinking improvement, and scientific research ability expansion, as well as higher total questionnaire scores than the control group, with statistically significant inter-group differences (P<0.001) (**Table 2**).

Table 2. Comparison of autonomous learning effect scores of medical staff between the two groups (points, Mean ± SD)

Group	Number of cases	Autonomous learning initiative	Knowledge understanding depth	Clinical thinking improvement	Scientific research ability expansion	Total score
Observation group	20	22.32±1.50	21.95±1.60	22.12±1.45	21.62±1.70	88.01±5.22

Control group	20	18.62±2.10	18.21±2.02	17.93±2.18	17.55±2.33	72.31±6.82
t value	-	6.425	6.218	7.012	6.158	8.265
P value	-	<0.001	<0.001	<0.001	<0.001	<0.001

3.3. Comparison of teaching satisfaction between the two groups

The training satisfaction rate of the observation group was 95.00%, which was significantly higher than 80.00% in the control group, and the inter-group difference was statistically significant ($P<0.05$) (**Table 3**).

Table 3. Comparison of teaching satisfaction of medical staff between the two groups [n(%)]

Group	Number of cases	Very satisfied	Satisfied	Dissatisfied	Satisfaction rate
Observation group	20	14(70.00)	5(25.00)	1(5.00)	19(95.00)
Control group	20	9(45.00)	7(35.00)	4(20.00)	16(80.00)
x^2 value	-	-	-	-	4.114
P value	-	-	-	-	0.043

4. Discussion

Basic medical continuing education is a core link in the standardized training of young clinical talents. Its training quality directly affects the clinical knowledge reserve, basic operation standardization, and clinical thinking ability of medical staff, serving as a crucial cornerstone for the continuous improvement of clinical post competency [9]. The traditional centralized training model previously adopted in our hospital has a single teaching form and limited resource supply, featuring one-way knowledge output by teachers and passive knowledge reception by trainees without active exploration and in-depth thinking. Meanwhile, the limited duration of practical training fails to meet trainees' needs for repeated practice and error correction, resulting in the common problem of proficient theoretical memory but non-standard clinical operation and disconnection between basic theories and clinical scenarios, which cannot adapt to the training standards of applied clinical medical talents in the new era [10].

Optimized based on in-hospital teaching practice, the blended teaching model in this study breaks the fixed process of traditional continuing education and constructs a full-process closed-loop training system. The pre-class online guidance link decomposes abstract and difficult core theories of basic medicine through lightweight and visualized teaching resources, and urges active preview via task-driven methods, effectively enhancing trainees' autonomous learning awareness. In addition, teachers accurately grasp trainees' learning weaknesses based on platform learning data, transforming offline classroom teaching from indiscriminate lecturing to targeted teaching and greatly improving classroom relevance. The offline in-class teaching abandons cramming education, carries out interactive discussion teaching focusing on pre-class learning pain points combined with clinical cases, and shortens the gap between basic theories and clinical practice. The virtual-reality integrated practical training model makes up for the deficiencies of insufficient practical training frequency and inadequate personalized guidance in in-hospital teaching, helping trainees master standardized basic operations and improve operational standardization.

The online after-class review and expansion and diversified process evaluation mechanism corrects the traditional assessment drawback of attaching importance to final examinations while neglecting learning processes, guiding trainees to focus on daily knowledge accumulation and regular review to realize continuous knowledge internalization and progressive competency improvement. The study data showed that the observation group had significantly better theoretical and practical assessment scores, comprehensive abilities including autonomous learning, clinical critical thinking, and scientific research expansion, and higher training satisfaction than the control group. These findings fully demonstrate that the blended teaching model can effectively solve the existing pain points of in-hospital basic medical continuing education, balance knowledge imparting, skill training, and literacy improvement, and conform to the lifelong, precise, and practical reform trend of continuing medical education.

This study has certain limitations. It is a single-center and small-sample teaching practice with limited research coverage and no long-term follow-up observation of post-competency. Future studies will further expand the sample size, carry out multi-center controlled trials in cooperation with multiple medical institutions, refine hierarchical training schemes according to the teaching characteristics of different basic medicine disciplines such as anatomy, physiology and pathology, continuously optimize online teaching resource allocation and in-hospital teaching procedures, and improve the blended teaching system of basic medicine adapted to medical institutions, so as to provide more comprehensive practical support for the reform of medical continuing education.

5. Conclusion

The optimized online and offline blended teaching model applied in in-hospital basic medical continuing education can effectively make up for various shortcomings of traditional centralized teaching, significantly improve medical staff's mastery of basic theories and standardization of clinical operations, effectively cultivate trainees' autonomous learning ability and comprehensive clinical critical thinking literacy, and enhance the satisfaction of in-hospital continuing medical education. With stable training effects, strong operability, and high adaptability, this teaching model meets the needs of hierarchical training of clinical post talents. It can be adopted as a regular reform scheme for basic medical continuing education in medical institutions and promoted in in-hospital and peer medical institutions.

Disclosure statement

The author declares no conflict of interest.

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