Original Article

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Impact of an educational supervision mechanism on blended teaching outcomes in general practitioner transfer training: a comparative study

Impacto de un mecanismo de supervisión educativa sobre los resultados de la enseñanza combinada en la formación de reorientación de médicos generales: un estudio comparativo

Huaying Liu[1,*], Qun Liang[2], Li Hui Meng[1], Le'an Pan[1], Guan Feng Qin[1], Jun Qiang Huang[1], Yan Liu[3]

[1] Department of Medicine, Guangxi Health Science College, Nanning, China.
[2] Guangxi University of Chinese Medicine, Nanning, China.
[3] Vocational Skills Training Institute, Guangxi Health Science College, Nanning, China.

ABSTRACT

Objectives: This study aimed to evaluate the effectiveness of a blended teaching model under an educational supervision mechanism in general practitioner (GP) transfer training. **Methods:** A non-randomized, historical cohort study was conducted involving 147 trainees. The intervention group (2025 cohort, n = 70) was managed under an educational supervision mechanism, in which a supervision team monitored and evaluated teaching quality throughout the training process, while the historical control group (2024 cohort, n = 77) received conventional blended training without formal supervision. Theoretical assessment scores were collected for both groups, while questionnaire satisfaction responses were gathered only from the intervention group. Analysis of covariance (ANCOVA) adjusting for pre-training scores was used to compare post-training outcomes. **Results:** The intervention group achieved significantly higher overall theoretical assessment scores compared with the historical control group (median [IQR]: 92 [88-95] vs. 90 [80.5-95]; p = 0.044; rank biserial correlation [r = 0.16]). After adjusting for baseline performance via ANCOVA, the adjusted marginal mean post-training score was 90.59 (95% confidence interval [CI]: 88.58-92.60) in the intervention group and 87.23 (95% CI: 85.32-89.15) in the historical control group, with a significant difference (F = 5.706, exact p = 0.018, partial $\eta 2$ = 0.038). In addition, 84.29% of trainees in the intervention group reported very satisfied (score = 5) of the model. However, only 75.71% considered the training content fully met daily clinical demands. **Conclusions:** Given the limitations of the single-center historical cohort design and potential temporal confounding, these findings should be interpreted with caution, although they suggest potential for broader application in medical education.

Keywords: Clinical Supervision; General Practitioners; Training Transfer; Comparative Study (source: MeSH NLM).

RESUMEN

Objetivos: Este estudio tuvo como objetivo evaluar la efectividad de un modelo de enseñanza semipresencial bajo un mecanismo de supervisión educativa en la formación de reconversión para médicos generales. **Materiales y métodos:** Se realizó un estudio de cohortes históricas no aleatorizado en el que participaron 147 personas en formación. El grupo de intervención (cohorte de 2025; n = 70) fue gestionado mediante un mecanismo de supervisión educativa, en el cual un equipo supervisó y evaluó la calidad de la enseñanza durante todo el proceso formativo. Por su parte, el grupo de control histórico (cohorte de 2024; n = 77) recibió formación semipresencial convencional sin supervisión formal. Se recopilaron las puntuaciones de las evaluaciones teóricas de ambos grupos, mientras que las respuestas al cuestionario de satisfacción se obtuvieron únicamente del grupo de intervención. Para comparar los resultados posteriores a la formación se utilizó un análisis de covarianza (ANCOVA), ajustado por las puntuaciones previas a la formación. **Resultados:** El grupo de intervención obtuvo puntuaciones generales significativamente más altas en la evaluación teórica que el grupo de control histórico (mediana [RIC]: 92 [88-95] frente a 90 [80,5-95]; p = 0,044; correlación biserial por rangos [r = 0,16]). Después de ajustar por el desempeño basal mediante ANCOVA, la media marginal ajustada de la puntuación posterior a la formación fue de 90,59 (intervalo de confianza [IC] del 95%: 88,58-92,60) en el grupo de intervención y de 87,23 (IC del 95%: 85,32-89,15) en el grupo de control histórico, con una diferencia significativa (F = 5,706; p exacto = 0,018; η^2 parcial = 0,038). Además, el 84,29% de las personas en formación del grupo de intervención manifestó estar muy satisfecho con el modelo (puntuación = 5). Sin embargo, solo el 75,71% consideró que el contenido de la formación respondía plenamente a las demandas de la práctica clínica cotidiana. **Conclusión:** Dadas las limitaciones inherentes al diseño de cohortes históricas realizado en un único centro y la posibilidad de confusión temporal, estos hallazgos deben interpretarse con cautela, aunque sugieren que el modelo podría tener posibilidades de aplicación más amplia en la educación médica.

Palabras clave: Supervisión Clínica; Médicos Generales; Transferencia de Entrenamiento; Estudio Comparativo (fuente: DeCS Bireme).

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***Correspondence**
Huaying Liu
liuhy23@163.com

INTRODUCTION

China continues to face a persistent shortage of general practitioners (GPs). Despite the implementation of various governmental training initiatives, the number of GPs per 10 000 population has not yet reached the national target or the level observed in developed countries [1]. With the ongoing advancement of China's new healthcare reform and the implementation of the "Healthy China" strategy, strengthening the primary healthcare system and cultivating a high-quality GP workforce have become urgent priorities [2].

At present, China implements standardized transfer training programs for physicians from other specialties who intend to transition into general practice [1]. GP transfer training is a national continuing medical education program in China designed for licensed practicing physicians from non-general-practice specialties to transition into general practice [1]. It represents one of the most critical strategies for rapidly expanding the GP workforce by enabling experienced physicians to become qualified GP [3,4]. GP transfer training in China adopts a 1-2-year program that integrates theoretical instruction, skills training, and clinical rotations. Practicing specialists who complete the training and pass relevant assessments may obtain professional qualifications as GP [4]. However, the theoretical foundations and technical requirements of general practice differ substantially from those of specialized medicine, necessitating strict and standardized training [1]. The traditional centralized teaching model has difficulty addressing the prominent conflict between work and study among in-service physicians, as well as the increasingly diversified learning needs of trainees, resulting in suboptimal training outcomes. To address these challenges, a blended teaching model integrating online and offline instruction has been adopted [5,6].

Internationally, online-offline blended teaching has become a mainstream teaching paradigm in continuing medical education, which can effectively solve the time-space constraints of in-service physician training and improve learning flexibility [5]. Systematic reviews have confirmed that structured blended teaching significantly improves learners' theoretical mastery and learning engagement compared with single offline teaching [7]. To ensure teaching quality, various supportive measures have been proposed, among which the education supervision mechanism has been recognized as an effective approach that has long been regarded as a core quality assurance tool in Western medical education systems [8,9].

In medical education, educational supervision and clinical supervision are two distinct standardized management mechanisms [9]. Clinical supervision focuses on bedside clinical skill guidance, patient management, and clinical competency assessment, targeting trainees' practical clinical performance [8]. In contrast, educational supervision is a teaching quality management mechanism oriented to curriculum implementation, including standardized inspection of teaching design, classroom teaching quality, online learning progress, teaching consistency, and teaching effect evaluation. It aims to unify teaching standards, standardize teaching behavior, and remedy the heterogeneity of teachers' teaching styles in continuing medical education, rather than intervening in clinical practice [9].

GP transfer training is predominantly delivered by senior hospital physicians and experienced faculty members from educational institutions [4]. The coexistence of academic and clinical instructors, each with distinct teaching styles, poses challenges to establishing unified teaching standards applicable to both educational and clinical settings [3].

Although previous domestic and international studies have confirmed the effectiveness of blended teaching in medical continuing education and demonstrated the crucial role of educational supervision in guaranteeing teaching quality, relevant evidence is primarily derived from undergraduate medical education and standardized residency training [5,6]. Few studies have focused on the unique in-service general practitioner transfer training context [4-6]. Specifically, it remains unclear whether supplementary educational supervision can further optimize the outcomes of existing blended teaching models, and whether supervision mechanisms can effectively resolve the uneven teaching quality caused by mixed teaching teams with diverse teaching styles in transfer training. To fill this research gap, this study aimed to explore the effects of a blended teaching model under an educational supervision mechanism in GP transfer training. The findings can enrich the contextual application of Starfield's primary care theory, Hattie and Timperley's feedback theory and Cruess's professional identity construction theory in continuing medical education for in-service physicians, provide empirical evidence for standardized quality management of GP transfer training, and offer a reference scheme for blended teaching reform of primary care workforce development [10].

METHODS

Participants

This study was conducted at Guangxi Health Science College, an officially designated national training base for GP transfer training in China. All training programs strictly followed the unified national and regional standardized syllabi for in-service GP transfer training, ensuring standardized training content, teaching hours,

and assessment criteria across different cohorts.

Trainees enrolled from September to December 2024 were assigned to the historical control group, while those enrolled from September to December 2025 were assigned to the intervention group. Baseline theoretical assessments were completed for all participants prior to the commencement of formal training activities in each cohort.

Inclusion criteria were as follows: 1) Inclusion criteria were as follows: 1) meeting the national official admission requirements for GP transfer training (i.e., holding a valid clinical practitioner license, working in primary healthcare institutions, and obtaining institutional approval to participate in the training); 2) completing all scheduled clinical rotations required by the unified training syllabus; 3) voluntarily signing informed consent to join the research; and 4) being specialist physicians with valid practicing qualifications.

Exclusion criteria were as follows: 1) dropped out owing to objective special reasons including long-term sick leave, job transfer out of primary medical institution or prolonged clinical duty absence that prevents regular attendance of theoretical courses; and 2) cases with missing core examination or questionnaire data which cannot be supplemented.

Baseline characteristics were collected before training commencement using a self-designed paper-based baseline information form, including sex, educational background, professional title, workplace and professional qualification.

Post-hoc power analysis was performed using G*Power 3.1 based on the observed effect size ($r = 0.16$), with $\alpha = 0.05$. For the primary outcome of theoretical score comparison ($n_1 = 70$, $n_2 = 77$), the calculated statistical power was 0.52, lower than the conventional threshold of 0.8, indicating limited statistical power of the current sample size.

Study methods

Selection of Tutors and Supervisors

Based on the requirements of the GP transfer training syllabus, a total of 20 instructors were selected. All instructors were either senior academic staff from the training base or senior physicians actively practicing in affiliated hospitals. All instructors held formal university teaching qualifications, had completed general practice teacher training at or above the college level, and possessed valid general practice teaching certificates. Each instructor was responsible for a specific module of the curriculum, including general practice fundamentals, doctor-patient communication, preventive care, chronic disease management, acute-on-chronic illness recognition and management, and primary care referral (Table S1 in the Supplementary Material). The two groups shared identical teaching faculty with unchanged instructors' professional titles during the research. Meanwhile, unified teaching materials and consistent theoretical assessment criteria formulated per official training syllabus were adopted for both cohorts.

Teaching Implementation

Both the historical control group and intervention group adopted a unified standardized blended teaching system based on the national and regional GP transfer training syllabi, with a consistent one-year full training cycle. The entire teaching scheme included 84 class hours of online teaching and 74 class hours of offline centralized teaching, with clear phased online-offline integration arrangements. All online learning activities were uniformly conducted via the Chaoxing Learning Platform (Chaoxing Co., Beijing, China), a widely used cloud-based learning management system in China. This platform supports the release of teaching resources including micro-lectures and slides, tracking of online learning duration and task completion, online assignments, quizzes, and teacher-student communication. It was introduced to Guangxi Health Science College in 2018 and served as the core carrier to deliver the blended teaching intervention, distributing standardized teaching materials and collecting trainees' online learning data throughout the training period.

Historical control group: trainees received routine online-and-offline blended teaching without educational supervision. They completed all scheduled online courses and offline centralized teaching according to the unified training arrangement. Teachers independently arranged teaching progress and content, with no standardized whole-process teaching supervision and quality evaluation mechanism.

Intervention group: on the basis of the identical offline blended teaching framework and one-year training cycle, all teaching activities were fully supervised and managed by a dedicated educational supervision team consisting of general practice experts and professional educational administrators. The supervision team implemented whole-process monitoring, standard unification, quality inspection and teaching feedback optimization for online and offline teaching links.

The specific teaching procedures were as follows:

1) Pre-class online self-directed learning (supported by Chaoxing Learning Platform): before offline centralized teaching, trainees completed pre-class preview through platform-released PPT resources, micro-lecture videos and targeted learning materials within specified online

class hours. Teachers tracked trainees' online learning duration, task completion status and learning progress in real time, answered online questions timely and summarized common learning difficulties to support targeted offline teaching design.

2) In-class offline interactive learning (74 class hours): relying on the problems and key difficulties summarized from pre-class online learning, teachers carried out centralized offline teaching. Combined with problem-based learning, case-based learning and scenario simulation teaching strategies, offline classroom discussion, skill practice and knowledge consolidation were organized to realize targeted teaching and deepen trainees' knowledge internalization.

3) Post-class consolidation and extension (supported by Chaoxing Learning Platform): After offline courses, trainees completed online homework, standardized assessments and thematic learning discussions within the stipulated online class hours. Teachers gave targeted corrections, learning feedback and individualized guidance based on trainees' online learning performance and offline classroom performance, forming a closed-loop online-offline integrated teaching mode.

Education Supervision System

To ensure professionalism, representativeness, and objectivity, the education supervision team consisted of six general practice experts and educational administrators from the training base and affiliated teaching hospitals. All supervisors held the title of professor or chief physician and had more than 10 years of teaching experience. Prior to implementation, centralized discussions were conducted to define supervision frequency, random classroom observations, teaching material reviews, teacher-student interviews, and feedback and improvement mechanisms. In terms of supervision frequency, random classroom inspections were carried out at least once for each teaching module, and bi-weekly regular supervision meetings were held. The duration of each supervision session shall be no less than one class-hour, with a total cumulative duration of 48 class-hours.

Supervising experts conduct rigorous evaluations based on the pre-established teaching evaluation checklist, which covers dimensions including classroom design, lesson-plan development, courseware quality, in-class interaction, accuracy of knowledge points, case quality, AI-enabled interaction implementation, and classroom management. For the closed-loop feedback mechanism, problems identified during supervision were recorded quantitatively, fed back to teachers in a timely manner, targeted rectification suggestions were provided, and follow-up re-inspection and effect verification were conducted to form a complete closed-loop management system of "supervision-guidance-feedback-rectification-improvement". Following each supervision session, one-on-one verbal and structured written feedback is provided to teaching faculty. Behavioral and disciplinary oversight is administered by a dedicated teaching secretary.

Outcome Evaluation

Both baseline pre-training and post-training theoretical assessments adopted a 0-100-point scoring system with pre-training assessments for both groups uniformly administered one day before training initiation. Post-training unified theoretical examinations were conducted immediately following completion of the training program. All examination questions were randomly extracted from the official GP standardized training question bank. To ensure equivalent examination difficulty and consistent evaluation standards between the two years, test papers for the 2024 and 2025 cohorts were compiled using a stratified random sampling method with identical proportions of knowledge domains and equivalent difficulty levels, rather than using exactly identical test questions. The same two senior professors were responsible for paper compilation for both cohorts, ensuring consistent question-setting criteria, difficulty control, and evaluation fairness across the two batches of assessments. Each examination paper contained 100 single best answer multiple-choice items covering six core domains of the transfer training syllabus: general practice basic theories, doctor-patient communication, preventive medicine, chronic disease management, identification and handling of acute on chronic critical illness, and primary care referral decision-making (Table S2 in the Supplementary Material). Although content domain weightings were harmonized, subtle differences in overall examination difficulty could not be completely excluded and were treated as a potential temporal confounding factor.

Satisfaction survey: A questionnaire was used to assess trainees' satisfaction with the teaching methods, course content, and overall effectiveness of the blended teaching model. Responses were recorded on a 5-point Likert scale (1 = very dissatisfied; 2 = dissatisfied; 3 = neutral; 4 = satisfied; 5 = very satisfied). This instrument was adapted from the validated Clinical Learning Evaluation Questionnaire (CLEQ) [11]. Minor modifications to item wording were performed to align the original scale with the context of Chinese GP transfer training, while retaining the core dimensional framework of the original CLEQ. The adapted questionnaire underwent local pilot-testing among a small group of trainees prior to formal data collection; Cronbach's $\alpha > 0.9$ was obtained from this pilot sample. The total satisfaction score was calculated

as the sum of all item scores, with higher scores indicating greater satisfaction. All questionnaires were paper-based and completed anonymously and were collected by two trained research assistants. Both research assistants hold bachelor's degrees in medicine and were members of the research team. Before formal data collection, they received unified training covering study background, standardized questionnaire administration, informed consent procedures, anonymous data collection requirements, and quality control protocols. The training also included practice sessions to resolve potential on-site questions raised by trainees.

Statistical analysis

Data were independently entered by two researchers using a double-entry method and verified by a third investigator. Statistical analyses were performed using SPSS version 26.0. Continuous variables with a normal distribution were expressed as mean ± standard deviation ($\bar{x} \pm s$), and between-group comparisons were conducted using independent-samples t tests. Continuous variables with a non-normal distribution were expressed as median (interquartile range), and comparisons were performed using the rank-sum test. Categorical variables were expressed as percentages (%) and compared using the χ^2 test. Effect size was reported using rank biserial correlation r for non-normal continuous outcomes. A p-value < 0.05 was considered statistically significant.

Ethical aspects

This study was conducted in accordance with the Declaration of Helsinki and approved by the Committee of Ethics of Guangxi Health Science College. The ethical approval documents are included in the project application dossier (Project No. 2025ZJY325). All participants were fully informed of the study objectives and procedures and provided written informed consent before enrollment.

RESULTS

General Characteristics of Trainees

According to the inclusion and exclusion criteria, all eligible trainees during the study period were invited to participate. Ultimately, 77 trainees were assigned to the historical control group, and 70 trainees were assigned to the intervention group. No eligible trainees declined study participation in either cohort. Different educational interventions were implemented, followed by performance analysis. A satisfaction survey regarding the blended teaching model under the education supervision mechanism was conducted among the 70 trainees in the intervention group. All 70 questionnaires were distributed, collected, and deemed valid, yielding a response rate of 100%.

Among the 147 participants, 68 were male (46.3%). Educational background included junior college (48, 32.7%), bachelor's degree (95, 64.6%), and postgraduate degree (4, 2.7%). Professional titles were distributed as follows: residents (64, 43.5%), attending physicians (50, 34.0%), and senior professional titles (33, 22.5%). Thirty-four trainees (23.1%) were from secondary or higher-level medical institutions, 50 (34.0%) from township health centers, 57 (38.8%) from community health service centers, and 6 (4.1%) from village clinics.

No statistically significant differences were observed between the two groups in terms of age, sex distribution, educational background, professional title, or level of medical institution ($p > 0.05$). Detailed results are presented in Table 1. Figure 1 shows the participant flow diagram of trainee selection.

Table 1. Comparison of general data between the two groups of trainees

Item	Historical control group (n = 77)	Intervention group (n = 70)	p-value*
	n (%)	n (%)	
Male	35 (45.5)	33 (47.1)	0.870
Work unit			
Secondary medical institution	18 (23.4)	16 (22.9)	0.972
Township health center	26 (33.8)	24 (34.3)	
Community health service center	30 (39.0)	27 (38.6)	
Village clinic	3 (3.9)	3 (4.3)	
Educational background			
Junior college	24 (31.2)	24 (34.3)	0.913
Bachelor's degree	51 (66.2)	44 (62.9)	
Postgraduate degree	2 (2.6)	2 (2.9)	
Professional title			
Residents	34 (44.2)	30 (42.9)	0.987
Attending physicians	26 (33.8)	24 (34.3)	
Senior professional	17(22.1)	16 (22.9)	

*Between-group comparisons of categorical variables were performed using the χ^2 (chi-square) test.

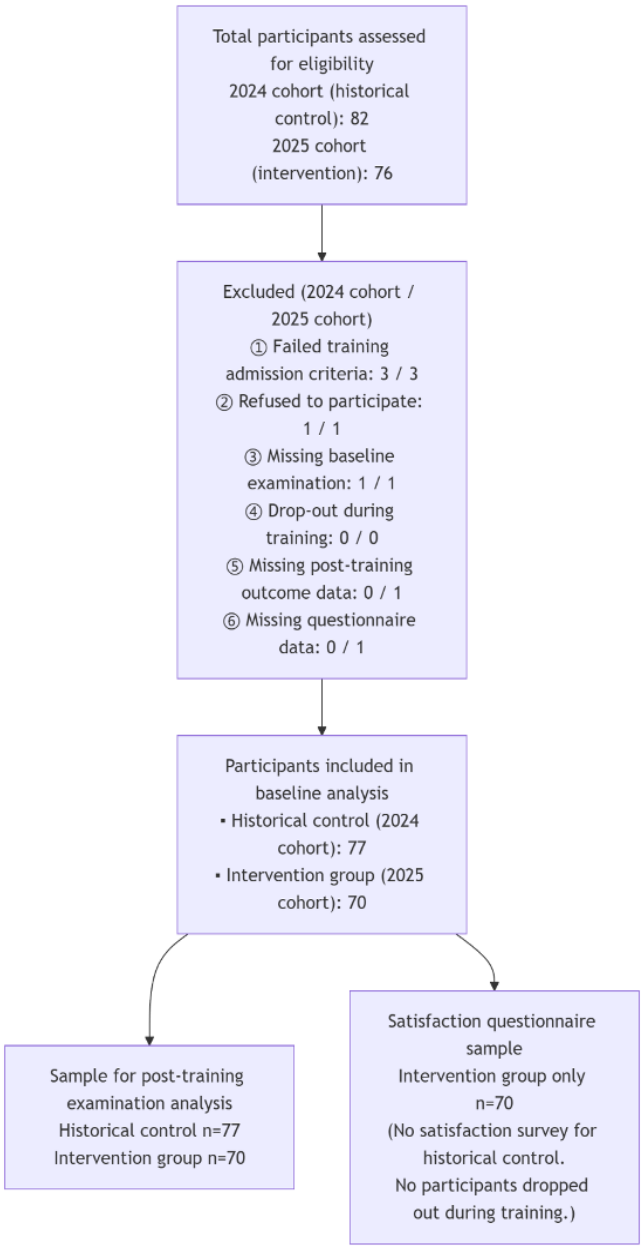

Figure 1. Participant flow diagram of trainee selection.

Comparison of Assessment Scores

Baseline pre-training placement test demonstrated no significant difference in initial theoretical proficiency between the two cohorts. Intra-group comparison revealed obvious knowledge improvement after training for both groups. Based on the teaching modules, unified examination content was adopted for post-training theoretical assessment. After completion of the training, the theoretical knowledge scores of the intervention group were significantly higher than those of the historical control group (92 [IQR: 88-95] vs. 90 [IQR: 80.5-95]; p = 0.044), as shown in Table 2, with an effect size of r = 0.16 indicating a small-to-moderate intervention effect.

In the intervention group, a correct response rate of 100% was achieved for the following items: risk factors of type 2 diabetes mellitus, understanding of the doctor-patient relationship, health consultation for cardiovascular diseases, the family-centered health care concept, the definition of life-cycle health care, and classification of mental disorders. The second-highest correct response rate (98.5%) was observed for items including the patient-centered health care concept, basic community survey methods, general principles of doctor-patient communication, transmission routes of hepatitis B, and classification of the most severe infectious diseases under China's statutory infectious disease system.

Analysis of covariance (ANCOVA) was used to compare post-training scores with pre-training baseline scores as the covariate. After baseline adjustment, the adjusted marginal mean post-training score was 87.23 for the historical control group and 90.59 for the intervention group. There was a significant difference between the two groups (F = 5.706, p = 0.018, partial η2 = 0.038). The pre-training score showed no significant predictive effect on post-training performance (F = 0.416, p = 0.520), consistent with balanced baseline scores at enrollment, as shown in Table 2.

Table 2. Unadjusted and ANCOVA-adjusted comparisons of pre-training and post-training examination scores between cohorts

Variable	Historical control group (n=77)	Intervention group (n=70)	p-value
Pre-training			
Median (IQR)	60 (50-71)	60 (53-70)	0.715*
Mean ± SE	61.86 ± 1.68	62.67 ± 1.70	
Post-training			
Median (IQR)	90 (80.5-95)	92 (88-95)	0.044*
Mean ± SE	87.23 ± 1.06	90.59 ± 0.90	
ANCOVA-adjusted			
Raw post-training score (mean ± SD)	87.23 ± 9.32	90.59 ± 7.44	-
Adjusted post-training marginal mean (95%CI)	87.23 (85.32-89.15)	90.59 (88.58-92.60)	0.018
Covariate: pre-training score	-	-	0.520

SE: standard error, IQR: interquartile range, SD: standard deviation, CI: confidence interval, ANCOVA: Analysis of Covariance.
*The pre-training and post-training scores were all analyzed using the Mann-Whitney U test (data not normally distributed).

Figure 2 shows pre-training score distributions across the two groups. Both cohorts shared an identical median baseline score of 60 points with comparable data dispersion; only sporadic high outliers appeared in the intervention group, demonstrating balanced pre-intervention academic levels. As displayed in Figure 3, all participants obtained markedly improved scores post-training. The intervention group had a higher median post-training score and tighter data concentration relative to the historical control group.

Satisfaction Evaluation

A satisfaction survey evaluating the blended teaching model under the education supervision mechanism was conducted among trainees in the intervention group. The evaluation included five response options: "very satisfied", "satisfied", "neutral", "dissatisfied", and "very dissatisfied". The survey assessed satisfaction with teaching methods, teaching content, instructional design, training duration, improvement in professional competence, applicability to clinical practice, and overall satisfaction. The results indicated that 84.3% (59/70) of trainees expressed high overall satisfaction with the supervised blended teaching model, and 82.9% (58/70) reported high satisfaction with the teaching methods, content, and outcomes. However, only 75.7% (53/70) believed that the training content fully met the demands of daily clinical practice. Additionally, 80.0% (56/70) of trainees were very satisfied with the time allocation. Detailed results are presented in Table 3.

DISCUSSION

By analyzing the examination results and questionnaire responses of trainees participating in GP transfer training, this research observed higher post-training theoretical examination scores in the intervention cohort receiving educational supervision compared with the 2024 historical control cohort. For physicians who are already in clinical practice, transfer training should be designed in alignment with their specific work characteristics. Based on the results of theoretical assessments, trainees under a blended online-offline teaching model showed a solid grasp of fundamental theoretical knowledge, indicating that this instructional approach is effective. Questionnaire findings further revealed that 84.3% of trainees approved of the blended teaching model. This high satisfaction rate aligns with Hattie & Timperley's theory on the power of feedback, wherein structured educational supervision provides specific, timely guidance that bridges the gap between teaching intent and learner uptake [10]. Compared with previously adopted

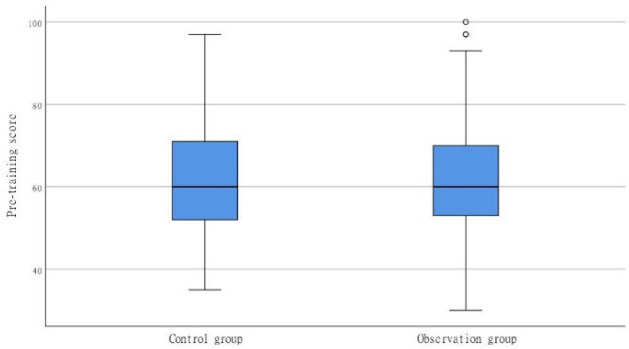

Figure 2. Baseline theoretical examination score distribution before training.

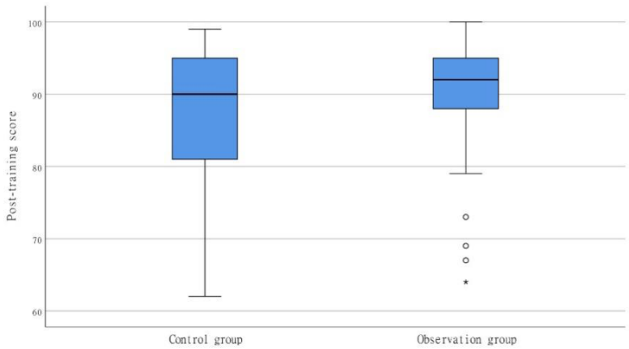

Figure 3. Post-intervention theoretical examination score distribution after training.

Table 3. Satisfaction of 70 general practitioners receiving post-transfer training

Item	Very satisfied	Satisfied
	n (%)	n (%)
Training effectiveness	58 (82.9)	12 (17.2)
Satisfaction with supervised blended teaching model	59 (84.3)	11 (15.7)
Training content fully met the demands of daily clinical practice	53 (75.7)	17 (24.3)
Time allocation	56 (80.0)	14 (20.0)
Satisfaction with the teaching effectiveness of each chapter		
Basic concepts and theories of general practice	53 (75.7)	17 (24.3)
General practice work skills and norms	47 (67.1)	23 (32.9)
Chronic disease management	58 (82.9)	12 (17.1)

All participants selected only "satisfied" or "very satisfied" for every questionnaire item; no respondents chose the neutral, dissatisfied, or very dissatisfied rating categories. The universal positive feedback may be affected by social desirability bias due to on-site questionnaire distribution and collection.

blended teaching approaches without supervision, the introduction of an educational supervision mechanism can further enhance teaching effectiveness. However, trainee feedback also indicated that only 75.7% believed that the training content adequately met the demands of daily clinical practice, highlighting the need for further refinement and adjustment of training content.

At present, the distribution of medical resources in China remains characterized by marked urban-rural disparities. To address the bottleneck of workforce shortages in primary care, the Chinese government has explicitly identified the "expansion of the implementation scope of GP transfer training" as an important strategy. In China, GP training for medical students typically follows the "3+2" assistant GP model or the "5+3" GP training model [12]. For graduates without a background in general practice, transfer training represents a more efficient pathway than the longer "5+3" standardized residency training to rapidly transform existing clinicians into qualified GPs, thereby offering a pragmatic and time-efficient solution for optimizing the primary care workforce structure [13].

Currently, GP transfer training in China adopts a 1-2-year program that integrates theoretical instruction, skills training, and clinical rotations [4]. Our institution serves as the theoretical teaching center for GP transfer training in our province. All participating trainees hold valid physician licenses and possess prior clinical experience. Given the particularities of their employment, some trainees are required to continue undertaking part of their original work during the training years. Theoretical instruction consists of two weeks of intensive on-site teaching and two weeks of concentrated online teaching, making a blended online-offline model theoretically well suited to this context. This model can substantially enhance learner engagement by enabling trainees to make effective use of fragmented learning time through online resources, while allowing focused, in-depth discussion of key learning difficulties during limited on-site sessions. Moreover, as all trainees have prior clinical experience, their learning needs and difficulties vary considerably. Personalized engagement with online resources allows trainees to identify problems in advance and adopt a problem-oriented approach during face-to-face sessions, thereby facilitating more targeted learning and feedback. Since 2023, our institution has consistently employed a blended teaching model for theoretical training [14]. Examination results have been generally satisfactory, indicating that this approach is appropriate for this group of trainees. Nevertheless, results from the 2024 assessments suggest that there remains room for further improvement in theoretical knowledge acquisition.

To further enhance teaching effectiveness and promote better mastery of relevant knowledge, our center introduced an educational supervision mechanism in 2025 to support teaching activities. Instructors involved in theoretical training come from diverse institutions, including medical school faculty and senior clinicians from hospitals. While these instructors possess strong academic and professional expertise in their respective fields, this does not necessarily guarantee effective teaching performance. Variations in teaching style and pedagogical competence necessitate a supervision mechanism to monitor, evaluate, and guide teaching practices, with the goal of continuous improvement. In fact, educational supervision is a well-established and routine approach in many countries, including China [15,16].

The results of this study indicate that participants receiving educational supervision enhanced blended teaching exhibited relatively higher assessment scores for GP transfer training. Although the between-group difference reached statistical significance (small-to-moderate effect), the absolute score increment was modest, suggesting the supervision intervention produced measurable yet limited practical promotion on theoretical performance. The partial $\eta 2$ indicated a small-magnitude intervention effect. Although the inter-group difference reached statistical significance, the modest effect size suggested that the practical educational improvement brought by educational supervision was limited rather than substantial. However, this research acknowledge that improvements in the online platform, evolving faculty experience, or changes in the 2025 trainee cohort could also contribute to these differences. As expected, this research also notice that several test items showed a 100% correct rate among all trainees. Rechecking the test content revealed that these items covered fundamental routine clinical knowledge that all participants had mastered before the training, leading to insufficient item discrimination and ceiling effects. This is also a limitation that this research must acknowledge. Specifically, educational supervision helps align online learning resources with offline teaching objectives. Through continuous procedural monitoring, it may optimize the integration and implementation of pre-class, in-class, and post-class teaching links. This model could mitigate the temporal and spatial limitations of conventional blended training and moderately improve trainees' active learning engagement [17]. These findings are partially consistent with the professional identity formation framework proposed by Cruess *et al.*, which emphasizes that standardized and structured educational experiences contribute to reshaping physicians' professional role cognition [18].

The positive trainee feedback in this single-center cohort further supports the preliminary practical value of the optimized teaching strategy. Nevertheless, given the single-center quasi-experimental nature, historical cohort design with potential annual temporal confounding, as well as the small intervention effect size, causal inference

cannot be reliably established based on current data. The observed improvements are relatively limited, and the generalizability and stable application effect of this model need to be further verified in future multi-center and large-sample prospective studies. Despite the above limitations, this study still provides certain practical implications for training administrators, curriculum designers, and health education policymakers. For teaching administrators, whole-process educational supervision can be adopted as an effective auxiliary management tool to standardize blended teaching procedures and reduce irregularities in online and offline training. For curriculum designers, the integration of standardized pre-class preview, targeted offline teaching, and post-class consolidation helps form a stable blended teaching framework and optimize resource allocation for general practice training. For policy makers, this study offers preliminary field evidence supporting the incorporation of teaching supervision mechanisms into standardized general practice training management, so as to continuously improve the quality of regional primary medical education.

Although 84.3% of trainees expressed strong approval of the supervised blended teaching model, feedback analysis revealed that only 75.7% believed that the transfer training content adequately met the requirements of their daily clinical work. This discrepancy highlights a critical gap between theoretical knowledge acquisition and practical competency, a challenge consistent with Starfield *et al.*'s emphasis on the complexity of primary care delivery [19]. This finding suggests that the training content still does not fully align with real-world clinical practice. At present, the training modules are designed according to national standards in China and cover core components such as fundamental concepts of general practice, preventive care, basic general practice skills, and competencies in chronic disease management. Classroom feedback indicated that trainees showed greater interest in the practical management of chronic diseases, particularly the timely handling of acute and critical conditions, which represented some of the most challenging aspects of their clinical work. In contrast, trainees appeared less inclined to devote extensive instructional time to conceptual discussions on person-centered, family-oriented, and community-based care, preferring instead a greater emphasis on chronic disease management.

Limitations

Several limitations warrant consideration. First, the single-center, historical cohort design introduces significant temporal confounding, limiting causal inference. Although the core teaching faculty remained identical throughout the two-year period, instructors may have accumulated teaching experience, and the online learning platform underwent iterative updates. These factors, rather than the educational supervision intervention, could account for the observed differences in post-training examination scores. Second, the reliance on theoretical exam scores and self-reported satisfaction surveys, rather than objective clinical performance metrics, restricts the generalizability of our findings. Third, the satisfaction survey was administered only to the intervention group, while no satisfaction data were collected from the control cohort. Therefore, only descriptive statistics of satisfaction outcomes are reported, and intergroup inferential comparisons could not be performed. Fourth, post-hoc power analysis revealed the statistical power of primary outcome was only 0.52, below the standard 0.8 threshold. The sample size led to insufficient statistical power. Fifth, two separate sets of examination papers were used for the two cohorts. While question banks and domain weightings were harmonized, subtle differences in examination difficulty cannot be completely excluded as a confounding source.

Under the implementation of the educational supervision mechanism, the blended teaching model was associated with improved quality of GP transfer training and higher trainee satisfaction. While promising, the single-center, quasi-experimental nature of this study limits causal inference. Further prospective, multi-center trials with longer follow-up are warranted to confirm these effects.

Supplementary Material

The supplementary material can be accessed at the following link: https://revistas.cientifica.edu.pe/index.php/mecp/article/view/4056/1880

Author contributions

HYL: Conceptualization, Methodology, Writing – Original Draft, Writing – Review & Editing. QL, LHM, LP, GFQ, JQH and YL: Investigation, Data Curation, Formal Analysis, Writing – Review & Editing. All authors assume full responsibility for the content of the manuscript.

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Conflict of interest statement

No conflicts of interest.

Data availability statement

The data used and/or analyzed during the present study are available from the corresponding author upon reasonable request.

Generative Artificial Intelligence use statement

No artificial intelligence was used in any part of the manuscript preparation process.

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ORCID

Huaying Liu: https://orcid.org/0000-0003-0230-537X

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