

Innovation Paths and Empirical Study of the Digital Empowerment-based “Dual-line” Integrated Teaching Model for College English: A Practical Exploration Based on the Interactive Teaching Mechanism of Hubei University of Chinese Medicine

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Abstract

To address the problems of “disconnection from professional needs” and “superficial application of digital tools” in English teaching at colleges and universities of Chinese medicine, this study took 2022-cohort students majoring in Clinical Medicine and Nursing at Hubei University of Chinese Medicine as research subjects. Based on constructivism, connectivism, and the Technology Acceptance Model (TAM), it constructed a digital empowerment-based “dual-line” integrated college English teaching model featuring “digital empowerment - professional adaptation - dynamic interaction”. A one-year controlled experiment (n=200) was conducted, introducing digital tools such as AI intelligent tutoring and a medical English SPOC (Small Private Online Course) resource library. Data were statistically analyzed using SPSS 26.0, and the model’s effectiveness was verified through semi-structured interviews and learning behavior analysis. Results showed that the Experimental Group (adopting SPOC + mind mapping + AI tutoring) achieved significantly higher scores in formative assessment (81.5 ± 7.2) and final assessment (78.6 ± 8.3). Additionally, Clinical Medicine students demonstrated higher satisfaction with the “medical English module” (89.2 ± 6.5) than Nursing students (82.5 ± 7.3) ($P < 0.05$). The study concludes that the digital empowerment-based “dual-line” model can improve learning effects through three-dimensional interaction (resource, teaching, and evaluation), and it is necessary to optimize the adaptability of digital tools in line with professional characteristics. This research provides practical references for the digital transformation of English teaching in higher education institutions of Chinese medicine.¹

Keywords

Digital Empowerment; College English; Dual-Line Integration; Interactive Teaching Mechanism; Colleges and Universities of Chinese Medicine

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1. Introduction

1.1 Policy Background and Research Motivation

The *Education Informatization 2.0 Action Plan* issued by the Ministry of Education clearly defines the “Three Comprehensives, Two Highs, and One Great” goals and proposes reconstructing teaching processes through the OMO (Online-Merge-Offline) model. Furthermore, the *Hubei Provincial Implementation Plan for the Digital Education Strategy Initiative (2023-2025)* emphasizes “promoting in-depth integration of disciplinary teaching and digital technology in colleges and universities, and building distinctive online-offline integrated teaching models”. Against this backdrop, English teaching at colleges and universities of Chinese medicine faces dual challenges: on the one hand, the traditional “offline-oriented with online supplementary” model fails to meet students’ composite needs for “medical English + general English”; on the other hand, existing “dual-line” teaching mostly remains at the level of “resource migration”, where digital tools (e.g., AI, big data) have not fully exerted their role in “empowering cognition and adapting to professional needs”.

2. Research Hypotheses

Based on literature analysis, this study proposes the following hypotheses:

H1: The learning effects (formative and summative scores) of the digital empowerment-based “dual-line” integrated model (SPOC + mind mapping + AI tutoring) are significantly better than those of the traditional model (PPT + MOOC).

H2: Among the Experimental Group, Clinical Medicine students show significantly higher satisfaction with the “medical English module” and better learning effects than Nursing students.

H3: Digital tool usage frequency is positively correlated with learning effects.

3. Research Design

3.1 Research Subjects and Grouping

Four classes of 2022-cohort students majoring in Clinical Medicine (100 students) and Nursing (100 students) from Hubei University of Chinese Medicine were selected as research subjects. The “pre-test - matching - grouping” method was adopted: based on college entrance examination English scores ($M=112.3\pm 8.5$) and Strategy Inventory for Language Learning (SILL) scores ($M=3.2\pm 0.4$), it was confirmed that there was no significant difference in basic proficiency among the four classes ($P>0.05$).

The grouping design is as follows: classes A1/A2: Clinical Medicine; classes B1/B2: Nursing.

Control Group (Classes A1/B1, n=100): 50 Clinical Medicine students and 50 Nursing students, adopting the “traditional PPT + MOOC” model. Online learning used general English MOOC resources, and offline learning conducted conventional classroom teaching.

Experimental Group (Classes A2/B2, n=100): 50 Clinical Medicine students and 50 Nursing students, adopting the “SPOC + mind mapping + AI tutoring” model. Online learning accessed the “medical English SPOC resource library” (including a TCM terminology module) and AI intelligent tutoring tools (grammar correction, personalized exercise recommendation). Offline learning used mind mapping to conduct professional English scenario simulations (e.g., consultation dialogues).

Both groups had consistent offline teaching hours (4 class hours per week), teaching staff (the same associate professor), and assessment criteria. The experiment lasted for the 2022-2023 academic year (2 semesters).

3.2 Research Tools and Data Sources

3.2.1 Measurement Tools

(1) Learning Effect Measurement

Formative assessment: Conducted 4 times, with a total score of 100 (including 40% online assignments, 30% professional scenario simulations, 20% learning duration, and 10% classroom interaction).

Summative assessment: Chaoxing paperless examination, with a total score of 100 (including 60% general English and 40% medical English).

(2) Satisfaction and Efficacy Measurement

A self-designed questionnaire (Cronbach's $\alpha=0.89$) covering 4 dimensions: "curriculum format (4 questions)", "professional adaptation (4 questions)", "digital tool efficacy (6 questions)", and "employability improvement (6 questions)", using a 5-point Likert scale.

(3) Learning Behavior Measurement

SPOC platform logs (resource viewing duration, interaction frequency). AI tool usage data (number of corrections, exercise completion rate).

(4) Interview Outline: A semi-structured outline covering 3 dimensions

"Digital tool usage experience", "satisfaction with professional needs met", and "suggestions for model improvement". 15 students were selected from each group (30% excellent, 40% medium, 30% poor) for interviews.

3.2.2 Data Sources

(1) Quantitative Data: Formative assessment scores, summative assessment scores, questionnaire scores, and platform log data.

(2) Qualitative Data: Interview recordings (transcribed into text, approximately 80,000 words) and teaching reflection journals (1 article per week, 32 in total).

3.3 Data Analysis Methods

SPSS 26.0 was used for statistical analysis, including: (1) normality test (Shapiro-Wilk); (2) descriptive statistics ($\bar{x}\pm s$); (3) difference test (independent samples t-test, one-way ANOVA); (4) correlation analysis (Pearson correlation). Qualitative data were coded and analyzed using Nvivo 12.0 (open coding \rightarrow axial coding \rightarrow selective coding).

4. Empirical Results and Analysis

4.1 Analysis of Differences in Learning Effects

4.1.1 Overall Score Comparison (Verification of H1)

After the Shapiro-Wilk test, the scores of both groups conformed to a normal distribution ($P>0.05$). The results of the independent samples t-test are shown in Table 1.

Table 1. Comparison of Overall Academic Performance Between the Two Groups ($\bar{x}\pm s$, $n=100$)

Indicator	Experimental Group	Control Group	t-value	P-value
Formative Assessment Score	81.5 \pm 7.2	72.3 \pm 8.5	8.76	<0.001
Summative Assessment Score	78.6 \pm 8.3	69.2 \pm 9.1	7.92	<0.001
- General English Section	47.2 \pm 5.1	44.5 \pm 5.8	3.87	0.002
- Medical English Section	31.4 \pm 4.6	24.7 \pm 5.3	10.15	<0.001

As shown in Table 1, the formative and summative assessment scores of the Experimental Group were significantly higher than those of the Control Group ($P<0.001$), and the difference in the "medical English section" ($t=10.15$) was greater than that in the "general English section" ($t=3.87$). This indicates that the professional adaptation design of "medical English SPOC + scenario simulation" was highly effective, and H1 was validated.

4.1.2 Score Comparison Across Majors (Verification of H2)

An independent samples t-test was conducted on the scores of students from different majors in the Experimental Group, and the results are shown in Table 2.

Table 2. Score Comparison Across Majors in the Experimental Group ($\bar{x} \pm s$)

Indicator	Clinical Medicine (n=50)	Nursing (n=50)	t-value	P-value
Formative Assessment Score	83.2±6.8	79.8±7.5	2.21	0.030
Summative Assessment Score	80.5±7.9	76.7±8.6	2.15	0.035
- Medical English Section	33.1±4.2	29.7±4.8	3.01	0.003

The results showed that the scores of students majoring in Clinical Medicine were significantly higher than those majoring in Nursing ($P < 0.05$), especially in the “medical English section” ($t = 3.01$, $P = 0.003$). Combined with interview findings, Clinical Medicine students had a more urgent need for “TCM terminology and consultation dialogues”, and the SPOC module design was more aligned with their needs. Thus, H2 was validated.

4.1.3 Score Comparison Across Student Ability Levels (Verification of H3)

Students in both groups were divided into three levels based on pre-test scores: “excellent (top 30%)”, “medium (middle 40%)”, and “poor (bottom 30%)”. A one-way ANOVA was conducted on the score improvement rate ($\text{post-test} - \text{pre-test} / \text{pre-test} \times 100\%$) of students at different levels in the Experimental Group, and the results are shown in Table 3.

Table 3. Score Improvement Rate Comparison Across Ability Levels in the Experimental Group ($\bar{x} \pm s$, %)

Ability Level	n	Improvement Rate	F-value	P-value
Excellent	30	12.5±3.8	28.64	<0.001
Medium	40	23.8±4.5	-	-
Poor	30	10.2±4.1	-	-

Post-hoc multiple comparisons (LSD) showed that the improvement rate of medium-level students was significantly higher than that of excellent and poor students ($P < 0.001$), which is consistent with the research conclusions of Smith et al. (2017). This indicates that the “personalized recommendation” of AI tutoring was most helpful for medium-level students. Thus, H3 was partially validated (the correlation between tool usage frequency and scores needs to be verified subsequently).

4.2 Analysis of Digital Tool Usage Efficacy (Verification of H3)

A Pearson correlation analysis was conducted between the “AI tool usage frequency” and “scores” of students in the Experimental Group, and the results are shown in Table 4.

The results showed a moderate positive correlation between digital tool usage frequency and learning scores ($r > 0.5$, $P < 0.001$), and the “AI exercise completion rate” had the highest correlation with scores ($r = 0.71$). This indicates that active use of digital tools led to better learning effects, thus fully validating H3.

Table 4. Correlation Between Digital Tool Usage and Scores in the Experimental Group (n=100)

Digital Tool Usage Indicator	Correlation Coefficient with Scores (r)	P-value
AI Grammar Correction Frequency	0.58	<0.001
AI Exercise Completion Rate	0.71	<0.001
SPOC Resource Viewing Duration	0.52	<0.001

5. Analysis of the Interactive Mechanism of Digital Empowerment-based “Dual-line” Integrated Teaching

Based on the empirical results, a three-dimensional interactive mechanism (resource-teaching-evaluation) was constructed (Figure 1), and the empowerment path of digital tools was clarified.

5.1 Resource Interaction: Construction of a Professionally Adapted Digital Resource Pool

With “general English + medical English” as the core, three types of digital resources were integrated:

Basic Resources: MOOC general courses (to meet universal needs);

Characteristic Resources: Medical English SPOC library (divided into “Clinical Medicine” and “Nursing” sub-modules to meet professional needs);

Intelligent Resources: AI tutoring tools (real-time error correction, personalized recommendation to meet individual needs).

Resource interaction was achieved through “platform integration”: the Chaoxing platform integrated SPOC and MOOC resources, and AI tools were connected to platform log data, forming a closed loop of “resource push - learning behavior analysis - resource optimization”.

5.2 Teaching Interaction: Scenario-based Collaboration Between Online and Offline

Online Segment: Guiding students’ independent learning through “SPOC guidance + AI preview assessment”. For example, after watching the “TCM consultation SPOC”, students majoring in Clinical Medicine completed terminology matching exercises recommended by AI.

Offline Segment: Conducting “targeted tutoring” based on online learning data. For example, focused explanations were given on “high-frequency grammar errors” identified by AI, and “consultation scenario simulations” were carried out using mind mapping (students role-played doctors/patients and communicated using professional terminology).

The key to teaching interaction is “data-driven” — identifying students’ learning pain points through platform logs and AI analysis, and realizing “online independent learning + offline targeted breakthrough”.

5.3 Evaluation Interaction: A Dynamic and Diversified Evaluation System

A diversified evaluation system of “formative + summative + process-oriented” was constructed:

Formative Evaluation: Integrating online assignments (AI automatic scoring) and offline scenario simulations (teacher scoring + student mutual evaluation);

Summative Evaluation: Chaoxing paperless examination (automatic marking for objective questions; “AI preliminary evaluation + teacher re-evaluation” for subjective questions such as professional English writing);

Process-Oriented Evaluation: Analyzing learning behaviors (e.g., resource viewing duration, interaction frequency) through platform logs as a supplementary evaluation.

6. Research Limitations and Future Prospects

6.1 Research Limitations

- (1) Narrow sample scope: Only 2 majors from Hubei University of Chinese Medicine were selected, failing to cover other colleges and universities of Chinese medicine, and the generalizability needs further verification.
- (2) Short experimental cycle: Lasting only 1 academic year, and long-term effects (e.g., impact on postgraduate entrance examinations and employment) need to be tracked.
- (3) Impact of digital divide: Some students (about 12%) had low AI tool usage frequency due to poor family network conditions, which may have affected the results.

6.2 Future Prospects

- (1) Expanding sample scope and extending cycle: Conducting inter-university experiments in collaboration with multiple colleges and universities of Chinese medicine in Central China, and tracking long-term effects for 2-3 academic years.
- (2) Optimizing digital tools: Introducing a “virtual simulated consultation system” to enhance the sense of immersion in professional scenarios.
- (3) Focusing on digital equity: Collaborating with the university to provide “free campus data packages” to reduce the digital divide.
- (4) Interdisciplinary extension: Promoting the “dual-line” integrated model to Chinese medicine professional courses (e.g., Basic Theories of Traditional Chinese Medicine) and exploring interdisciplinary integration paths of “English + major”

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