Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 6
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Research on Flipped Classroom Teaching Mode Combining Evidence-based Medicine with Case Teaching

Huiping Liu, Xinru Li, Libo Zhou*, Miao Liu, Minghui Chu

School of Stomatology, Jiamusi University, Jiamusi 154007, Heilongjiang, China

Author to whom correspondence should be addressed.

Abstract: *Objective*: This research aims to explore the pedagogical impact of the flipped classroom methodology informed by Evidence - Based Medicine (EBM) and Case-Based Learning (CBL) on the clinical education of students specializing in oral mucosal diseases. The primary goal is to improve the overall clinical practical skills of dental students. *Methods*: A total of 184 interns from the Department of Periodontal Mucosal Diseases at the Stomatology College of Jiamusi University, who were enrolled in a five-year undergraduate program in oral medicine from May 2020 to September 2022, participated in the study. The interns were randomly assigned to either the control group, which received traditional teaching methods, or the experimental group, which experienced a flipped classroom model based on Evidence - Based Medicine (EBM) and Case - Based Learning (CBL). The effectiveness of the teaching methods was assessed at the end of the internship through theoretical examinations and questionnaire surveys, among other evaluation techniques. *Results*: The findings of the evaluation of teaching quality, the theoretical knowledge, clinical practice skills, and case analysis scores of the experimental group were 86.18 ± 6.62, 86.53 ± 6.86, and 87.10 ± 6.82, respectively. These values were significantly higher than those of the control group (79.71 ± 7.95, 72.52 ± 9.26, and 71.91 ± 9.04); students' overall quality and course satisfaction were statistically significant ($p < 0.05$) when compared to the control group. *Conclusion*: The flipped classroom teaching model based on Evidence-Based Medicine (EBM) and Case - Based Learning (CBL) effectively leverages the strengths of both methodologies. This combination not only improves traditional teaching methods, ignites students' enthusiasm for learning, and fosters innovative thinking, but also contributes positively to enhancing clinical practical skills. Overall, this educational approach significantly benefits the clinical training of periodontal mucosal diseases, increasing teaching effectiveness and satisfaction for both educators and students.

Keywords: Evidence-based medicine; Reform in education; The flipped classroom; Stomatology; Oral mucosal disease; Clinical logical thinking ability

Online publication: Jun 30, 2026

1. Introduction

Oral Mucosal Disease is a discipline-oriented practical curriculum that places stringent requirements on stomatology undergraduates' comprehensive quality and clinical research capacity. The clinical internship phase during undergraduate education serves as a critical transitional period from classroom learning to formal clinical practice, where the cultivation of students' critical thinking should be prioritized [1,2]. In conventional internship training dominated by teacher-centered demonstration and knowledge indoctrination, students learn passively, resulting in incomplete knowledge absorption and rigid mindset formation [3,4]. Against the backdrop of the "Internet Plus" initiative, the flipped classroom has gradually been introduced into medical education, enabling extracurricular autonomous learning and educational resource integration. Evidence-Based Medicine (EBM) integrates clinical data with exploratory thinking on the basis of scientific research to facilitate updated medical knowledge and standardized clinical diagnostic thinking [5,6]. Combined with the disciplinary features of Oral Mucosal Diseases, this study constructs an integrated flipped classroom teaching system incorporating EBM and Case-Based Learning (CBL), and evaluates its teaching efficacy to improve undergraduates' innovative capacity and comprehensive competency in stomatology.

2. Materials and methods

2.1. General information

A total of 184 five year program stomatology undergraduates undergoing clinical rotation at the Department of Periodontal and Mucosal Diseases, Affiliated Stomatological Hospital of Jiamusi University between July 2020 and July 2022 were enrolled; all participants fully understood the research content and volunteered for this study. Participants were randomly divided into a control group and an experimental group, ensuring equal representation in both. The control group comprised 38 males and 54 females aged 19 to 27 years, with an average age of (22.52 ± 3.53) years. In contrast, the experimental group consisted of 34 males and 58 females aged 19 to 28 years, averaging (22.54 ± 6.36) years old. Baseline data showed no statistically significant inter-group difference ($p > 0.05$), assuring comparability between cohorts. All participants provided informed consent, except for those who withdrew partway through the process. All teaching sessions for both groups were delivered by one experienced instructor proficient in clinical practice and pedagogy.

2.2. Teaching protocols

2.2.1. Control group

Teaching was based on the 5th edition of Oral Mucosal Diseases, published by People's Medical Publishing House, with multimedia-assisted instruction for each 45-minute class. Conventional teaching modes, including thematic lectures and typical case discussions, were adopted.

2.2.2. Experimental group

The flipped classroom guided by EBM principles combined with CBL was implemented within 45-minute teaching sessions following five specific procedures:

(1) In accordance with the 2019 Jiamusi University teaching syllabus, typical clinical cases such as oral lichen planus and recurrent aphthous ulcer were selected to elaborate clinical manifestations, predisposing factors, diagnostic criteria, differential diagnosis, therapeutic principles, and individualized regimens.

(2) Students retrieved and reviewed relevant literature to obtain authoritative clinical evidence for solving clinical puzzles and standardizing diagnostic and therapeutic protocols.
(3) Retrieved clinical evidence was screened and graded based on the evidence hierarchy to verify reliability and clinical operability.
(4) Supervising tutors guided in-depth case discussion during clinical practice, summarized disputed issues, and translated research conclusions into individualized patient treatment plans.
(5) Instructors guided students to collect all available clinical trial data throughout the curriculum and conduct a systematic assessment of relevant research outcomes.

2.3. Observation indicators

Three senior stomatology teachers with abundant clinical and teaching experience were assigned to evaluate teaching outcomes from four dimensions: written examinations, clinical skill assessment, curriculum satisfaction questionnaire, and comprehensive competency evaluation. All questionnaires were completed anonymously. Written tests mimicked the format of a national licensed physician written examination with a full score of 100; clinical operation and case analysis adopted a three-station interview mode identical to a licensed physician practical assessment with blind marking (full score:100 for each item). In the satisfaction survey, a score of 10 points indicates satisfaction, 8 to 9 points signifies basic satisfaction, and 4 to 5 points reflects dissatisfaction. Respondents who scored 6 points or higher were considered satisfied. In a comprehensive competency assessment, each indicator was scored 1–10 anonymously by students themselves, with higher scores standing for stronger corresponding abilities.

2.4. Statistical analysis

The SPSS 26 .0 program was used for all statistical analyses. Listing data were given as (n, %) and examined using the Chi-square test; measurement data were shown as mean, standard deviation, and compared using an independent sample *t*-test. $p < 0.05$ showed a statistically significant difference.

3. Results

3.1. Comparison of academic scores between two groups

Statistically higher scores in theoretical knowledge, clinical operational skills, and case analysis were observed in the experimental group versus the control group ($p < 0.05$), as detailed in **Table 1**.

Table 1. Comparison of teaching assessment scores between the two groups (Mean ± SD, n = 92)

Group	Theoretical knowledge	Clinical practical	Skills case analysis
Experimental group	86.18 ± 6.62	86.53 ± 6.86	87.10 ± 6.82
Control group	79.71 ± 7.95	72.52 ± 9.26	71.91 ± 9.04
t value	5.992	11.667	12.863
p value	**< 0.05**	< 0.05	< 0.05

3.2. Curriculum satisfaction survey

The experimental group demonstrated significantly greater overall satisfaction with the curriculum ($p < 0.05$).

Two students from the experimental group expressed dissatisfaction due to the excessive time cost of the new teaching mode, while 11 students in the control group were unsatisfied with the monotonous curriculum design and insufficient hands-on clinical opportunities, leading to low learning motivation (**Table 2**).

Table 2. Curriculum satisfaction comparison between two groups [n = 92, n (%)]

Group	n	Satisfied	Basically satisfied	Dissatisfied	Total satisfaction rate
Experimental group	92	80 (86.96)	10 (10.87)	2 (2.17)	90 (97.82)
Control group	92	49 (53.26)	32 (34.78)	11 (11.96)	81 (88.04)
χ^2					25.204
p					< 0.05

3.3. Comprehensive competency assessment

All comprehensive competency indicators of the experimental group outperformed those of the control group with statistical significance ($p < 0.05$), as shown in **Table 3**.

Table 3. Student comprehensive competency scores (Mean ± SD, n = 92)

Group	Learning interest & efficiency	Learning initiative	Communi cation ability	Teamwork capacity	Analytical	Skill problem-solving	Skill literature retrieval	Skill clinical thinking ability
Experimental group	8.79 ± 0.70	9.05 ± 0.54	8.72 ± 0.61	9.09 ± 0.63	18.06 ± 0.99	17.44 ± 0.95	16.57 ± 1.16	17.70 ± 0.64
Group control	8.01 ± 0.73	8.16 ± 0.77	8.22 ± 0.68	8.27 ± 0.65	15.21 ± 1.39	14.28 ± 1.54	13.12 ± 1.81	13.28 ± 1.45
t value	7.391	9.074	5.250	8.682	16.023	16.757	15.393	26.745
p value	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

4. Discussion

4.1. Limitations of traditional teaching methods

The report presented to the 20th National Congress of the Communist Party of China highlights a people-centered approach to educational development, the establishment of a high-quality education system, and the promotion of quality-oriented education [7–9]. It also focuses on the growth of foundational, emerging, and interdisciplinary fields, providing essential guidelines for curriculum - based ideological and political education across various aspects, including curriculum development, practical education, and the digitalization of ideological education [10]. Faculty development and the expansion of the educational framework. These elements collectively outline key objectives for the ongoing educational reform. Accelerated globalization of medical education and national science and technology revitalization strategy raise higher requirements for innovative medical talent cultivation and undergraduates' practical capabilities, making cultivation of high-quality interdisciplinary professionals a core mission for modern higher education in line with social development demands [11,12]. While solid theoretical grounding is essential for stomatology undergraduates, translating textbook knowledge into individualized clinical diagnosis and treatment remains a prominent challenge for graduating students. Traditional teacher-centric teaching has obvious limitations in practical training: it prioritizes knowledge indoctrination over on-site clinical observation, restricts

teacher–student interaction, deprives students of direct participation in clinical management, and dampens autonomous learning enthusiasm [13,14]. Most medical undergraduates complete four years of classroom theoretical learning before a one-year clinical internship, highlighting the vital role of clinical rotation in fostering self-directed learning and a smooth transition from student to clinician. Recent educational reforms advocate shifting from lecture-based passive teaching toward student-centered pedagogy featuring high-order thinking and active classroom engagement.

4.2. Application effect of EBM-CBL integrated flipped classroom in oral mucosal disease internship education

Medicine features strong professionalism and practicality alongside an evolving disease spectrum, continuously posing new challenges for clinical practitioners and raising competency benchmarks for medical graduates. Qualified clinicians require a robust theoretical foundation, evidence-based thinking, and basic research literacy. Rooted in authentic clinical scenarios, EBM guides personalized diagnosis and treatment by combining authoritative clinical evidence with individual patient conditions [15]. EBM training cultivates a standardized clinical decision-making mindset for students and requires instructors to master comprehensive basic medical disciplines, including anatomy, physiology, pharmacology, and pathology; meanwhile, learners shift from in-class passive listening to pre-class autonomous preview and interactive in-class discussion focused on clinical thinking development. Sharing an identical educational philosophy focused on inquiry-driven clinical problem-solving, CBL links textbook knowledge with real-world clinical practice to sharpen trainees' clinical reasoning and emergency management capacity.

Originating from self-regulated learning and constructivist learning theories [16,17]. The flipped classroom rearranges in-class and extracurricular learning time to transfer learning dominance from instructors to learners via pre-class independent knowledge acquisition and in-class collaborative discussion and knowledge application instead of cramming education. The combined EBM-CBL flipped classroom introduced in stomatology internship integrates respective pedagogical merits to shift education from passive knowledge infusion toward active problem -solving, effectively boosting independent learning, teamwork, and innovative clinical reasoning [18]. However, this teaching approach cannot be universally applied to all subject matter; future reforms should involve the development of tailored teaching strategies based on the learner's stage and the curriculum content. This will aid students in cultivating critical thinking through independent literature research, analytical speculation, and the integration of theory with practice. This study has inherent limitations, including a limited sample size and insufficient long-term follow-up constrained by academic schedule; further optimization of evaluation scales and expanded cohort will be implemented in subsequent research.

5. Conclusion

In conclusion, the integrated EBM and CBL flipped classroom mode significantly enhances undergraduates' learning initiative, comprehensive competency, and curriculum satisfaction, stimulates learning motivation and logical clinical thinking, alleviates clinical adaptation pressure, and facilitates a seamless combination of theoretical knowledge and clinical practice. It improves overall academic performance and achieves favorable teaching outcomes worthy of widespread promotion in clinical stomatology education.

Funding

Funded Projects Key Commissioned Project for Undergraduate Education and Teaching Reform in Higher Education in Heilongjiang Province (Project No.: SJGZ20220124); Education and Teaching Reform Project at Jiamusi University (Project No.: 2023JY6-50)

Disclosure statement

The authors declare no conflict of interest.

References

[1] Lin G, Tan W, Tan H, et al., 2023, Innovative Pedagogical Strategies in Health Professions Education: Active Learning in Dental Materials Science. Int J Environ Res Public Health, 20(3): 239–243.

[2] Shen J, Yuan L, Ge R, et al., 2022, Improving Medical Student Recruitment into Neurosurgery Through Teaching Reform. BMC Med Educ, 22(1): 656.

[3] Xu X, Wang Y, Zhang S, et al., 2022, Performance of Problem-Based Learning-Based Image Teaching in Clinical Emergency Teaching. Front Genet, 13: 931640.

[4] Blair R, Caton J, Hamnvik O, 2023, A Flipped Classroom in Graduate Medical Education. Clin Teach, 17(2): 195–199.

[5] Chen F, Lui A, Martinelli S, 2022, A Systematic Review of the Effectiveness of Flipped Classrooms in Medical Education. Med Educ, 51(6): 585–597.

[6] Mercuri M, 2024, The Ever-Shifting Source of Authority on What Works in Clinical Medicine. J Eval Clin Pract, 25(5): 703–705.

[7] Qi X, 2023, Advancing Standardized Resident Training Quality under the Guidance of the Spirit of the 20th CPC National Congress—Keynote Report at 2022 National Standardized Resident Training Summit. Chinese Journal of Continuing Medical Education, 7(1): 1–5.

[8] Yu K, Hu D, 2023, Traditional Chinese Medicine and Chinese Civilization: Research Series on "Two Integrations" of the Spirit of the 20th CPC National Congress (IV). Journal of Yulin Normal University, 44(2): 59–67.

[9] Yao G, 2023, Exploration on Chinese Modernization of Education Based on Educational Reform Practices since the 18th CPC National Congress and Relevant Statements from the 20th CPC National Congress. Journal of Inner Mongolia Normal University (Educational Science Edition), 36(3): 1–10.

[10] Gou L, Yao J, Guo H, 2022, Reflections on Evidence-Based Medicine Teaching among Undergraduates at a Medical University in Xinjiang. Xinjiang Medical Journal, 52(8): 992–994.

[11] Tao H, Liang L, 2022, Theoretical and Practical Exploration on Educational Administration of Medical Universities under Green Ecology Concept. Environmental Engineering, 40(10): 256.

[12] Wang J, Zhang R, He M, et al., 2020, Existing Problems and Countermeasures of Higher Education. Vocational Education, 2020(6): 8–9.

[13] Sao Y, Yeh W, Hsu T, et al., 2022, Implementing a Flipped Classroom Model in an Evidence-Based Medicine Curriculum for Pre-Clinical Medical Students: Evaluating Learning Effectiveness Through Prospective Propensity Score-Matched Cohorts. BMC Med Educ, 22(1): 185.

[14] Lu C, Xu J, Cao Y, et al., 2023, Examining the Effects of Student-Centered Flipped Classroom in Physiology Education. BMC Med Educ, 23(1): 233.

[15] Ji C, 2022, Highlight TCM Advantages and Cultivate Modern Evidence-Based Thinking: Reform Practice of Evidence-Based Medicine Teaching. Journal of Traditional Chinese Medicine Management, 30(11): 234–236.

[16] Tang B, Sandarage R, Chai J, et al., 2022, A Systematic Review of Evidence-Based Practices for Clinical Education and Health Care Delivery in the Clinical Teaching Unit. CMAJ, 194(6): E186–E194.

[17] Tee W, Tan S, Marican F, et al., 2022, Comparison of Digital Interactive Case-Based Educational Resource with Virtual Role Play in Dental Undergraduates in Clinical Oral Medicine/Oral Pathology Education. Healthcare (Basel), 10(9): 44567.

[18] Li P, Lan X, Ren L, et al., 2023, Research and Practice of the BOPPPS Teaching Model Based on the OBE Concept in Clinical Basic Laboratory Experiment Teaching. BMC Med Educ, 23(1): 882.