TBL-Flipped Classroom Model Design for Teaching Epidemiology to Graduate Medical Students

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Abstract: The continuous deepening of China's education reform has made the transformation of teaching methods the core focus of current education development. The integration of Team-Based Learning (TBL) with the Flipped Classroom model offers novel approach to reforming Epidemiology teaching. This blended model aligns with China's educational reform objectives, enhances the quality of medical education, cultivates high-caliber postgraduate medical professionals, and provides valuable insights for future innovations in medical education.

***Keywords*:** Team-Based Learning; Flipped Classroom; Epidemiology; Graduate Medical Education

1. Introduction

China′s recent round of curriculum reforms has placed significant transforming learning methods, identifying them as strategic priority. The institutionalization of student-centered teaching paradigms under these reforms greatly enhances cognitive abilities and critical thinking, optimizing learning efficiency and satisfaction, and facilitates personalized learning outcomes[1]. Rapid development of educational informatization has driven substantial innovations in teaching methodologies, with university instructors systematically integrating cutting-edge pedagogical concepts and digital technologies to create diversified instructional approaches[2, 3].

Team-Based Learning (TBL),as a structured collaborative learning model, shifts the instructor's role from being a transmitter of knowledge to a facilitator of cognitive development[4]. Meanwhile, the Flipped Classroom model, leveraging digital resources, restructures traditional learning time and space by integrating mastery learning theories with constructivist principles [5]. Internationally, the combined TBL-Flipped Classroom approach has demonstrated synergistic benefits-optimizing clinical decision-making, improving translational efficiency, and strengthening interprofessional collaboration and complex problem-solving abilities[6, 7]. Although still in exploratory use domestically, evidence indicates that, with well-designed cognitive preparation, this dual-mode approach can significantly enhance student engagement and conceptual mastery.

2. Current Status of Epidemiology Teaching for Graduate Medical Students

Public health's strategic importance in the medical system continues to grow, and Epidemiology, as a core methodological discipline in public health and has strong practical applications[8, 9]. At the postgraduate level, mastery of epidemiological principles and methods is crucial for contributing to medical, the traditional teacher-centered[9]. However, the traditional teacher-centered, knowledge transmission model struggles to address the inherent challenges of the discipline: (1) Complex theoretical depth coupled with practical abstraction; (2) high demands for statistical and mathematical logic skills; (3) the need to integrate multidisciplinary knowledge from medicine, biology, sociology, and related fields into a systematic framework; and (4) elevated requirements for critical thinking and the ability to solve complex problems independently. These factors hinder the internalization of theory and its practical application, constraining the development of research capacity. To meet the new era's demand for innovation and complex problem-solving, it is essential to move beyond traditional models and develop competency-oriented approaches aligned with disciplinary characteristics and postgraduate learning needs [10].

3. Significance and Value of the TBL–Flipped Classroom Model in Epidemiology Teaching

Integrating the TBL-Flipped Classroom model into Epidemiology teaching enables a dual-loop learning model "pre-class autonomous learning" followed by "in-class collaborative refinement". This structure leverages the social-cognitive momentum of team learning while maximizing classroom time for higher-order skill development. It supports cultivation

medical professionals. This blended model enhances self-directed learning, fosters critical thinking, and strengthens teamwork and problem-solving abilities, ultimately improving both the effectiveness of instruction and the quality of resources (e.g., medical documentaries, international open courses) to broaden perspectives and deepen understanding.

4. Design and Implementation of the TBL-Flipped Classroom Model in Epidemiology

The necessary infrastructure for implementing this model is already available. University's online teaching platform supports microlecture uploads and interactive communication. Faculty members possess extensive Epidemiology teaching experience and proficiency in educational technology, enabling the creation of high-quality multimedia resources. Research team members have relevant academic expertise to conduct data analysis and teaching research, ensuring smooth implementation. The construction and effect evaluation of the TBL-flipped classroom teaching mode of Epidemiology are shown in Figure 1.

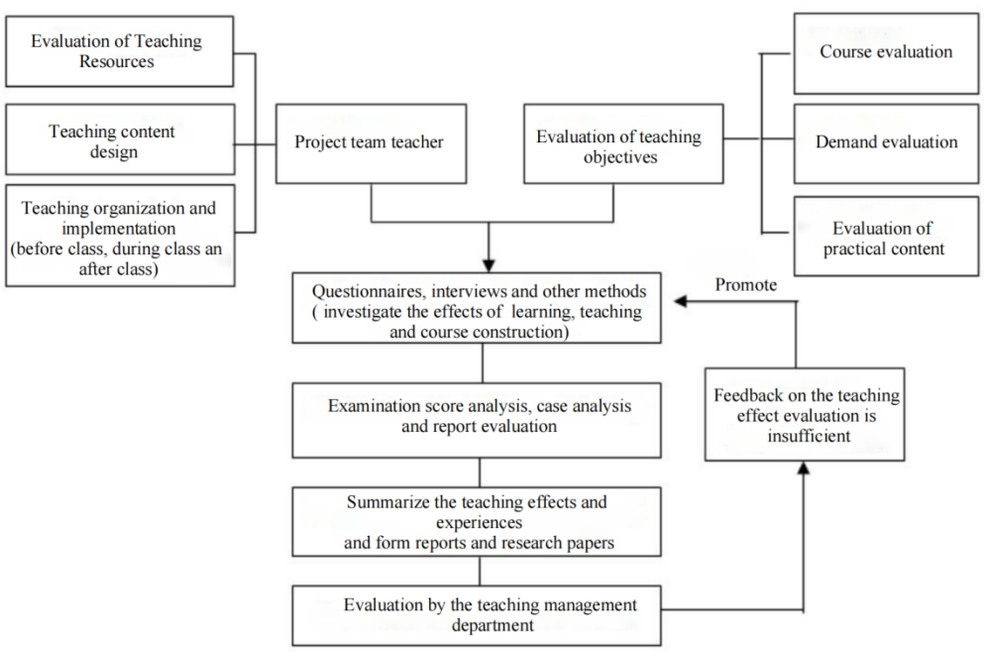

Figure 1. Implementation of the construction and effect evaluation of the "TBL-Flipped Classroom" model

4.1 Pre-class Preparation: Knowledge Delivery (Flipped Phase)

Instructors develop advanced learning resources based on the syllabus, organized into modular units with clear objectives and coherent content. (1) Microlectures (10-15 min/unit) on core topics (e.g., epidemiological principles, clinical research design, disease prevention models) enriched with dynamic visualizations (e.g., forest plots, animated survival curves). (2) Supplementary materials including PPT slides, e-textbooks, and curated literature (meta-analyses, clinical guidelines, landmark cohort studies) annotated with key methodological insights (e.g., bias control, statistical applicability). (3) Self-assessment quizzes and extended learning resources (e.g., medical documentaries, international open courses) to broaden perspective and deepen understanding. Students complete self-study, document challenges, and discuss them in groups. Group leaders compile and submit summary reports for instructor review.

4.2 In-class Phase: Knowledge Internalization (TBL Phase)

Through group work and personalized guidance, teachers guide students to delve into and solve complex issues in epidemiology. In-class teaching is an in-depth collaborative process: (1) Teachers assign practical problems through individual tests and team tests, and individuals and groups have in-depth discussions in the classroom. Each group discusses and reports on solutions, encouraging students to analyze epidemiological issues from multiple perspectives. Through this collaborative inquiry, students can understand knowledge points more comprehensively and form critical thinking.

(2) Implement interdisciplinary scientific research practice (4S principles) in class. The 4S principle is to design real and complex interdisciplinary problems of Significant Problems, integrating the multi-dimensional requirements of epidemiology, biostatistics and clinical medicine. The team submits a specific choice within a limited time, and the reason for choosing the method must be clarified. Through the Simultaneous Report presentation scheme, blind review scoring between groups was carried out to promote comparative reflection. Shared Accountability is adopted to ensure full participation. (3) The CATME scale was used to conduct mutual evaluation of member contributions, focusing on methodological contribution and critical questioning quality. Each group may encounter different problems in the process of cooperation, and teachers provide targeted guidance according to the problems of different groups. Teachers' comments and feedback at this stage are crucial to help correct students' understanding biases in a timely manner and ensure that each group is on the right track.

4.3 Post-class Phase: Consolidation and Extension

Post-class activities via the online platform, mainly including personal reflection logs, extended tasks and teacher optimization.(1)individual reflection and sublimation: writing a structured reflection journal should include the evolution path of scientific research design thinking, academic leadership reflection in teamwork, and method- ological defect improvement plans.(2)extended scientific research tasks:complete micro-scientific research projects and carry out literature methodological critique based on classroom plans.(3)dynamic teaching optimization system: teachers use platform data analysis (self-test question error clustering, discussion area hot words) to locate teaching weaknesses, establish an error knowledge base, and transform high- frequency misunderstandings into preparatory testing priorities for the next course.

5. Conclusion

TBL-flipped classroom teaching model actively responds to the strategic requirements of the "Healthy China 2030" Plan Outline for the cultivation of innovation ability of high-level medical talents, and closely aligns with the Ministry of Education's "Guiding Opinions on Accelerating the Innovation and Development of Medical Education" The core task of "strengthening medical students' scientific research thinking and practical ability". Through the three-order closed-loop design of high-level knowledge input before class, team scientific research decision-making in class and academic ability transfer after class, the fundamental task of "cultivating people with morality" and "three comprehensive education" are practiced concept, which realizes the implementation of policies in three dimensions. In the teaching reform of the "Epidemiology" course, the application of TBL and flipped classroom mode can not only enhance students' independent learning ability, but also promote the cultivation of teamwork and critical thinking. This is of great significance for cultivating high-quality medical talents that meet the needs of the country

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Author Contributions

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Informed Consent Statement

Not applicable.

Data Availability Statement

The research data for this survey can be obtained by contacting the corresponding author.

Conflicts of Interest

The authors declare no conflicts of interest.

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