

Construction and Practice of a Case-Driven Four-Element Integrated Teaching Model for Epidemiology

Yingping Yang, Menglin Wang, Chunyan Xu*

Department of Epidemiology and Health Statistics, School of Medicine, Tarim University, Alar 843300, Xinjiang, China

**Author to whom correspondence should be addressed.*

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: As a key basic discipline in medicine, epidemiology plays a critical role in cultivating clinical medical students' scientific research thinking and basic disease prevention and control capabilities. However, epidemiology is often regarded as a non-core subject, leading to low learning motivation and poor knowledge mastery and application among clinical medical students. To address these problems, we constructed and implemented a case-driven four-element integrated teaching model for epidemiology, consisting of four components: online preview via the Wisdom Tree platform, offline systematic theoretical teaching, case-based experimental teaching, and simulation-based practical training. Online preview helps students grasp basic course content; offline lectures consolidate theoretical foundations; case-based teaching strengthens practical application abilities; and simulation training enhances learning interest and applied skills. As the core link, case-based teaching effectively helps students understand abstract theories, stimulates learning interest, and cultivates practical abilities. Practice results show that this model significantly improved students' knowledge mastery, application abilities, learning attitude, and academic performance, and effectively fostered their scientific research thinking and capacity. It provides a valuable reference for epidemiology teaching reform.

Keywords: Epidemiology; Case-based teaching; Digital intelligence; Virtual simulation; Teaching model

Online publication: June 3, 2026

1. Introduction

Epidemiology provides a scientific basis for disease prevention, control, and treatment by studying the distribution patterns and influencing factors of diseases in populations^[1]. Under the background of New Medical Education, as a fundamental medical discipline, epidemiology is not only central to public health and preventive medicine but also irreplaceable in cultivating clinical medical students' scientific research thinking and disease prevention capabilities^[2,3]. For clinical medical students, mastering the basic theories and methods of epidemiology enables them to understand disease pathogenesis from a population perspective, thus improving the scientificity and accuracy of clinical diagnosis and treatment^[4,5].

However, because epidemiology is often classified as a non-core subject for clinical medicine majors, clinical students generally show low enthusiasm, poor knowledge mastery, and weak application ability in epidemiology courses^[6,7]. Many students neglect the course, lack classroom participation, and hold a passive learning attitude^[8,9]. Meanwhile, the highly theoretical and abstract content makes it difficult for students to understand, especially in complex epidemiological study designs and data analysis, where students often struggle to think clearly and organize their ideas effectively. In addition, students show extremely weak ability to apply epidemiological methods in research proposal writing or academic papers, failing to flexibly use knowledge to solve practical problems. These problems hinder learning effectiveness and the development of students' future clinical research and public health capabilities, making teaching reform urgently needed.

2. Construction of the four-element integrated teaching model

To solve the above dilemmas, faculty in our department designed a case-driven four-element integrated teaching model for epidemiology: Digital Intelligence – Theory – Case – Simulation. The components are as follows.

2.1. Online preview via the Wisdom Tree platform

As an important part of the four-element model, the online Wisdom Tree platform provides students with a flexible and autonomous preview environment. In epidemiology, students watch pre-recorded lecture videos to systematically learn basic concepts, methodological frameworks, and practical application cases. The platform also sets up a three-level assessment system: pop-up quizzes, chapter tests, and final examinations, which evaluate knowledge mastery from multiple levels and angles.

This preview method not only helps students familiarize themselves with course content in advance but also provides data support for teachers to target students' difficulties in subsequent teaching^[10-12]. Through online preview, students gradually develop autonomous learning ability and lay a solid foundation for in-depth offline learning.

2.2. Offline systematic theoretical teaching

Offline theoretical lectures are a core part of epidemiology teaching, aiming to help students build a solid theoretical foundation through systematic instruction. In this stage, teachers combine textbooks and cutting-edge disciplinary progress to focus on basic principles, study designs, and data analysis methods of epidemiological methodology. For example, teachers elaborate on the design and implementation of case-control studies, cohort studies, and randomized controlled trials, enabling students to theoretically understand their scope and precautions.

Meanwhile, teachers introduce and analyze classic cases to connect abstract theories with real application scenarios, deepening understanding and memory. Through systematic offline teaching, students not only master the basic theoretical framework of epidemiology but also develop scientific research thinking, laying a knowledge foundation for subsequent experimental and practical courses.

2.3. Case-based experimental teaching

2.3.1. Importance of case-based teaching

Case-based teaching is central to epidemiology instruction and important in three aspects:

Firstly, case-based teaching can effectively help students understand abstract epidemiological theories.

Since the methodology of epidemiology involves numerous statistical models and logical reasoning, relying solely on theoretical lectures often fails to enable students to fully grasp the essence of these theories. However, through the analysis of specific cases, students can transform abstract theoretical knowledge into practical skills that can be applied, thereby deepening their understanding of the knowledge^[13].

Secondly, case-based teaching can significantly stimulate students' interest in learning. Compared to traditional "spoon-feeding" teaching, case-based teaching uses real clinical problems or public health events as entry points, allowing students to experience the practical value of knowledge while solving problems, thereby enhancing their learning enthusiasm^[14,15].

Finally, case-based teaching helps cultivate students' practical application abilities. During the case analysis process, students need to comprehensively apply the knowledge they have learned, from problem identification, scheme design, to data analysis and result interpretation. This series of operations not only exercises their professional skills but also enhances their teamwork and communication and expression abilities.

2.3.2. Case-based teaching process

The specific implementation process of the case-based teaching experiment course is divided into three key stages: independent problem-solving, teacher-guided optimization, and group assignment mutual evaluation. In the independent problem-solving stage, students work in groups to conduct an in-depth analysis of the epidemiological cases provided by the teacher. Each group needs to propose research hypotheses based on the case background, design research plans, and attempt to solve the practical problems within the cases. This process fully mobilizes the students' initiative, enabling them to learn to flexibly apply theoretical knowledge in practice. Subsequently, in the teacher-guided optimization stage, the teacher provides specific guidance to help students clarify the optimal solution and improve the research design. This stage not only corrects the possible deviations in the students' analysis process but also further strengthens their understanding of the methodology. Finally, in the group assignment mutual evaluation stage, each group uses a random anonymous method to rate and discuss the research results of the other groups. This approach not only promotes the exchange of ideas among students but also enables them to draw experience from the strengths and weaknesses of others. This then comprehensively enhances their knowledge level, application ability, and teamwork awareness^[13-15].

2.4. Offline simulation practical training

Offline simulation practical training is the final link of the four-element model, aiming to further strengthen students' ability to apply epidemiological methods by simulating real epidemiological events. In this stage, students use simulation systems to participate in the investigation and response to epidemiological events, such as emergency disposal of infectious disease outbreaks and risk factor screening for chronic diseases.

Highly realistic scenarios let students experience the full process of epidemiological investigation: on-site sampling, data collection, statistical analysis, and result reporting. This immersive learning increases course interest and significantly improves hands-on and adaptive abilities^[16-18]. In addition, simulation training emphasizes interdisciplinary integration, encouraging students to apply medicine, statistics, and information technology to solve problems, thus cultivating comprehensive quality and innovation ability.

3. Practical effects of the four-element integrated teaching model

3.1. Change in learning attitude

With the case-driven four-element model, students' learning attitude changed remarkably from passive to active. For example, in offline lectures and experiments, classroom participation increased significantly, with more active answering and group discussion. This attitudinal shift was also reflected in after-class behavior: students voluntarily looked up materials and solved practical problems, proving the model effectively stimulated learning motivation.

3.2. Improvement in learning outcomes

The specific data show that the adoption of the four-element integrated teaching model has significantly enhanced students' learning outcomes. Taking the final exam scores of clinical medical students in the 2022 and 2023 grades as an example, the average score of the 2022 grade students using the conventional teaching method was 65.76 points, while the average score of the 2023 grade students who adopted the four-element integrated teaching method rose to 77.98 points. The difference was statistically significant ($P < 0.01$). This result fully demonstrates the effectiveness of the four-element integrated teaching model in improving students' knowledge mastery rate. Additionally, through the statistical analysis of students' regular performance, it was found that students' performance in high-order thinking abilities, such as case analysis and experimental design, also significantly improved, further verifying the promoting effect of this teaching model on students' comprehensive learning ability.

3.3. Cultivation of scientific research ability

This course focused on training clinical students in case-control studies, cohort studies, and randomized controlled trials, developing advanced research thinking and preliminary scientific research capacity. For instance, in offline experiments and simulation training, students mastered study design, data analysis, and result interpretation by solving practical case problems.

The course also emphasized presentation and community communication skills, which are essential for future medical research and public health work^[4,7-9]. Many students reported significant improvement in research thinking and application ability, especially in designing and organizing epidemiological surveys, which greatly supported their participation in college innovation competitions such as the "Innovation and Entrepreneurship Program" and "Challenge Cup". This fully demonstrates the unique advantages of the four-element model in cultivating scientific research ability.

4. Conclusion

The case-driven four-element integrated teaching model for epidemiology organically combines online preview, offline theory, case teaching, and simulation practice, giving full play to the strengths of multiple teaching methods. Student-centered, integrating theory and practice, and highlighting case-based teaching as the core, this model effectively stimulates students' interest and initiative.

It not only improves students' mastery of basic epidemiological knowledge but also significantly enhances practical application ability and scientific research thinking, laying a solid foundation for training clinical medical professionals with advanced research thinking and preliminary research capacity^[19-21].

This teaching reform practice proves that the four-element model has obvious advantages in improving

learning motivation and outcomes. However, some problems emerged during implementation, such as insufficient participation in online preview and occasional “free-riding” in group work. In the future, teaching design should be further optimized: for example, adding online interactions to boost participation and improving group evaluation mechanisms to prevent free-riding. Meanwhile, new technologies such as virtual reality (VR) and AI-assisted teaching should be explored to enrich teaching methods and improve quality. In addition, teacher training should be strengthened to enhance the ability to integrate ideological and political elements and design diversified teaching models, thus better achieving the educational goal of fostering virtue through education^[22–25].

Funding

Top-tier Undergraduate Course Project of Tarim University: Epidemiology (Project No.: TDYLKC202455); Curriculum Ideological and Political Project of Tarim University: Epidemiology (Project No.: TDKCSZ22541); New Major Project of Tarim University: Preventive Medicine (Project No.: XBZYXJ202407)

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Huang LQ, Chen FM, Sun LY, 2023, Preliminary Study on Teaching Reform of Infectious Disease Epidemiology under the Background of Medical-Prevention Integration. *Education Teaching Forum*, 37: 68–71.
- [2] Fu T, Su HX, Wang B, et al., 2023, Exploration on Teaching Reform of Epidemiology under the Background of New Medical Education. *Medical Education Research and Practice*, 31(4): 459–462.
- [3] Liu Y, Cheng X, Pei R, et al., 2022, Thoughts on Ideological and Political Teaching Reform of Epidemiology under the Background of “New Medical Education”. *Journal of Chengdu University of Traditional Chinese Medicine (Educational Science Edition)*, 24(2): 130–132.
- [4] Zhao SH, Hou FF, Ding GY, 2025, Teaching Evaluation of Clinical Epidemiology among Professional Postgraduate Students. *China Higher Medical Education*, 9: 139–141.
- [5] Guo QT, Chen X, Fang HT, et al., 2026, Investigation on Teaching Demands of Epidemiology among Medical Students. *Nongken Medicine*, 48(1): 83–88.
- [6] Guo QT, Chen X, Guo H, et al., 2025, Investigation on Cognition of Epidemiology among Medical Students. *Medical Journal of Bingtuan*, 23(4): 58–61.
- [7] Li XH, Wu WJ, Ma Y, et al., 2022, Analysis on Satisfaction and Influencing Factors of Clinical Epidemiology Course Teaching for Medical Postgraduates. *Translational Medicine Journal*, 11(6): 337–340 + 359.
- [8] Li ZQ, Wu WJ, Ma Y, et al., 2023, Self-Assessment Survey on Postgraduates’ Scientific Research Ability Improvement in Clinical Epidemiology Teaching. *Journal of Medical Research*, 52(1): 186–191.
- [9] Liu Y, Li H, Ye YL, et al., 2024, Evaluation and Demand Analysis of Clinical Epidemiology Course Teaching Quality among Medical Master Graduates. *Xinjiang Medical Journal*, 54(11): 1399–1402.
- [10] Jia GZ, Wang PY, Wang YN, et al., 2025, Construction of Online-Offline Blended Teaching Model for Epidemiology Based on 3S Deep Learning. *Health Vocational Education*, 43(12): 50–54.

- [11] Lu YH, He S, Shen Y, 2022, Comparison of Online, Offline and Blended Teaching Effects of Epidemiology. *Journal of Traffic Medicine*, 36(4): 432–435.
- [12] Jiang ZY, Wang JH, Wang ZY, et al., 2021, “Rain Classroom + X” Online Teaching Practice and Enlightenment of Clinical Epidemiology for Clinical Medicine Majors. *Health Vocational Education*, 39(21): 53–55.
- [13] Xu L, Xiao JY, 2023, Thoughts on CBL Teaching Method in Undergraduate Epidemiology Courses. *Continuing Medical Education*, 37(10): 53–56.
- [14] Li JS, Guo YP, Zhang T, et al., 2022, Application of Flipped Classroom Combined with Case Analysis Teaching Method in Epidemiology Teaching. *Continuing Medical Education*, 36(8): 24–27.
- [15] Jiang YH, Mi J, Huang Q, et al., 2024, Analysis on Application Effect of CBL in Experimental Teaching of Epidemiology. *Huaihai Medical Journal*, 42(3): 323–325.
- [16] Zhao Y, Cao L, Wang JH, et al., 2025, Construction and Thoughts of Virtual Simulation Technology in Teaching of Epidemiology Principles and Methods. *University*, 26: 72–75.
- [17] Xu SL, Gao W, Liao YX, et al., 2025, Design and Application of Field Epidemiological Investigation Training System Based on Virtual Simulation and Artificial Intelligence Technology. *South China Journal of Preventive Medicine*, 51(3): 367–370.
- [18] Hu Q, Zhang Y, Xiang Y, et al., 2022, Application of Virtual Simulation System in Field Epidemiology Teaching. *New Medicine*, 32(4): 270–276.
- [19] Kang H, Lian C, Huo H, et al., 2025, Application of “1234 Four-in-One” Teaching Model in Epidemiology Teaching. *China Health Industry*, 22(11): 8–11.
- [20] Qiu FM, Yang L, Lyu JC, 2024, Thoughts and Practice on Blended Teaching Model Reform of Epidemiology. *Guangzhou Medical Journal*, 55(12): 1515–1519.
- [21] Zhao Q, Wang Q, Yang YN, et al., 2023, Effect and Evaluation of Combined Teaching Method Reform of Epidemiology on Improving Students’ Comprehensive Application Ability. *China Higher Medical Education*, 2: 96–98.
- [22] Liu F, Shao Y, He Y, 2021, Exploration of Ideological and Political Education in College Epidemiology Teaching. *Medical Education Management*, 7(S1): 49–53.
- [23] Li BZ, Su H, Jin X, 2025, Construction and Practical Thoughts on Ideological and Political Education of Epidemiology from the Perspective of Healthy China. *Science & Culture*, 15: 43–46.
- [24] Zeng ZP, Wang DQ, Yang Y, et al., 2022, Exploration of the Concept of Strengthening Morality and Fostering Talents in Ideological and Political Construction of Epidemiology. *University*, 15: 141–144.
- [25] Zhan TS, Yin DH, 2025, Teaching Practice and Thoughts on Ideological and Political Education of “Epidemiology” in Colleges and Universities. *Education Teaching Forum*, 48: 137–141.

Publisher’s note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.