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Application of Task-Based Embodied Learning and Flipped Classroom Integrated Teaching Model in Teaching Health Supervision

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Abstract: *Traditional teacher-centered methods in health supervision education limit students' initiative and practical skills, hindering their ability to solve complex public health problems. This study aims to investigate the effectiveness of an integrated teaching mode that combines task-based embodied learning (TBEL) with the flipped classroom (FC) in enhancing learning outcomes and practical skills in health supervision education. This study targeted the 2021 cohort of preventive medicine students at Youjiang Medical University for Nationalities. The control group received traditional instruction, while the experimental group was taught using an integrated model that combined TBEL with a flipped classroom approach. Teaching effectiveness was assessed through a health law knowledge test, a final examination, a health supervision skills assessment, and a teaching evaluation questionnaire. The results indicate that the integration of TBEL with the FC effectively enhances students' ability to apply knowledge and develop practical skills. These findings provide valuable insights for medical education reform and serve as a reference for teaching methodologies in other applied disciplines.*

Keywords: *Task-Based Embodied Learning, Flipped Classroom, Health Supervision, Health Education Reform*

1. Introduction

Health supervision is an applied course that integrates both health law and supervision practices, encompassing various fields such as the fundamentals of health law, health supervision of medical institutions, infectious disease prevention and control, and the supervision of public places. The primary objective of this course is to equip preventive medicine students with a solid foundation in health law and practical application skills, enabling them to accurately assess and respond effectively to public health emergencies. Given the increasing societal demands for public health professionals and the emergence of public health crises such as COVID-19, as well as potential outbreaks of unknown diseases, it is crucial to train students with the ability to identify and address complex problems[1].

Currently, the traditional Lecture-Based Learning (LBL) method remains the predominant instructional approach in health supervision education. This teacher-centered model follows a "one-person speaks, many listen" format, which, while effective in delivering systematic and standardized knowledge, often results in passive learning. Due to the lack of active engagement, students struggle to develop interest and intrinsic motivation, leading to suboptimal learning outcomes[2]. In recent years, alternative instructional methods, such as Problem-Based Learning (PBL) and Case-Based Learning (CBL), have been introduced to improve student participation and engagement[3]. While these approaches have enhanced students' enthusiasm for learning to some extent, they still fall short in providing immersive, context-rich practical experiences[4]. Consequently, they fail to fully develop students' comprehensive practical skills. This gap not only limits students' ability to transfer theoretical knowledge to real-world supervisory tasks but also hampers their decision-making

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and judgment skills in complex situations. Therefore, exploring more effective teaching models to enhance students' knowledge application and practical competencies has become an urgent necessity.

Embodied Learning (EL), developed from the theory of embodied cognition, emphasizes learning through bodily perception, action, and interaction with the environment, fostering deeper cognitive processing[5]. This approach is particularly effective when practiced in authentic contexts[6]. In the context of health supervision, real-world scenarios often involve fieldwork at supervised institutions. Task-Based Embodied Learning (TBEL), a specific EL paradigm, focuses on task-oriented learning, requiring students to apply theoretical knowledge in practical settings through a "learning-by-doing" approach[7]. Compared with traditional teaching models, TBEL significantly enhances students' initiative and practical abilities[8, 9].

Simultaneously, the Flipped Classroom (FC) model has emerged as an innovative instructional approach, shifting from a teacher-centered model to a student-centered, active learning framework[10]. In this approach, students first engage with course materials—such as online resources or textbooks—before class, allowing classroom time to be utilized for deeper exploration through teacher-student interactions, problem-solving activities, and discussions. This transition from passive to active learning has been shown to improve student engagement and overcome the limitations of LBL[11].By combining independent pre-class learning with interactive classroom sessions, FC not only expands the depth and breadth of students' knowledge but also cultivates their critical thinking and problem-solving skills[12].

To maximize the benefits of both instructional strategies, integrating TBEL within the FC model is essential. This combination creates a dynamic and interactive learning environment where students not only acquire theoretical knowledge beforehand but also apply it in real-world contexts, thereby enhancing their understanding and retention[13]. Additionally, this integration supports personalized learning pathways tailored to diverse learning styles while also fostering teamwork and communication skills[14]. Therefore, in the context of health supervision education, combining TBEL with FC can leverage the strengths of both models to optimize learning outcomes.

This study aims to investigate the effectiveness of integrating TBEL and FC in the teaching of health supervision. By comparing this hybrid model with traditional teaching methods, we seek to evaluate its impact on student engagement, mastery of health laws and regulations, comprehension of theoretical knowledge, and problem-solving skills in practical scenarios. The findings of this study will provide new ideas for the training of public health personnel in the new era and serve as a reference for teaching reform in related disciplines.

2. Methods

2.2 Study population and design

This study recruited 110 volunteers from fourth-year Preventive Medicine students (Class of 2021) at Youjiang Medical University for Nationalities between September 1, 2024, and October 1, 2024. Class 1 was designated as the control group, while Class 2 served as the experimental group, with each group comprising 55 students. The male-to-female ratio in Class 1 and Class 2 was 17:38 and 19:36, respectively, with an average student age ranging from 21 to 24 years. At the time of enrollment, both classes had identical average GPAs. Additionally, the instructor, syllabus, and total number of class hours (41) were kept consistent across both groups to ensure comparability. All participants provided written informed consent before being included in the study. This study utilized a prospective experimental control design.

2.3 Teaching interventions

2.3.1 Teaching methods in the control group

The control group was instructed using traditional teaching methods. The specific teaching process was structured as follows:

Pre-class preparation: The instructor provided the syllabus, clarified the learning objectives and content, and students engaged in independent pre-study based on the syllabus.

Classroom instruction: The instructor delivered lessons following the logical sequence of knowledge points, using the textbook in conjunction with multimedia presentations (e.g., PowerPoint)

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and the blackboard. To stimulate students' interest at the beginning of the lesson, the instructor introduced real-world cases or posed thought-provoking questions. During the lesson, key and challenging concepts were reinforced through additional case studies and relevant video demonstrations. Furthermore, students were encouraged to engage in deep thinking through guided questions, while group discussions were organized to foster peer interaction and collaborative problem-solving, thereby enhancing their comprehension and retention of the material.

End-of-class assessment: An online teaching platform (e.g., “Rain Classroom”) was used to conduct in-class quizzes, helping students consolidate their knowledge and assess their learning outcomes.

2.3.2 TBEL and FC Integration Teaching Mode (hereinafter referred to as the “Integration Teaching Mode”)

The experimental group adopted the Integration Teaching Mode, which was implemented in four stages (Fig 1). The teaching process was dynamically adjusted based on feedback after each session. Each new task was designed to build upon the experiential knowledge gained from previous tasks, facilitating knowledge reinforcement and innovation.

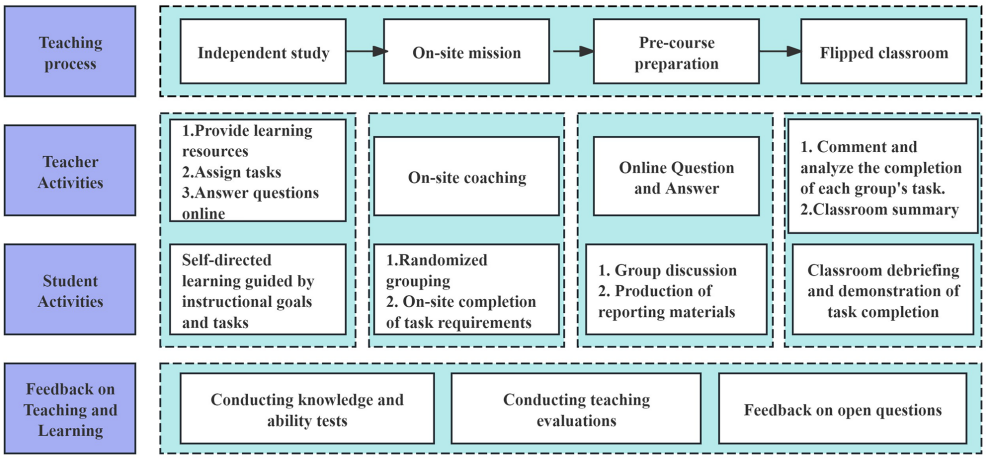

Fig 1: TBEL and FC Integration Teaching Mode.

Independent Learning. Before the course began, instructors communicated with students regarding learning objectives, content, and instructional methods. In addition to textbooks, students were provided with supplementary learning resources, including Review of Health Supervision Cases, Compilation of Laws and Regulations on Health Planning, and Practical Guide to Health Administrative Law Enforcement Instruments. Additional instructional materials such as educational videos, case studies, online courses, WeChat resources, and access to the Health and Health Supervision Network Training Platform were also made available. Subsequently, instructors distributed study task cards (Table 1) through the teaching QQ group. They also provided online support by answering students' questions in real time. Each student was required to complete the same set of task requirements.

On-Site Enforcement Tasks. Students were randomly assigned to groups of 6–7 members and dispatched to real-world locations (e.g., hotels, clinics) to conduct supervision and enforcement tasks. Prior to the task, the instructor consulted with the supervised units and obtained permission to introduce simulated violations, allowing students to practice identifying regulatory breaches. During the supervision and inspection process, students were required to complete official supervision documents, such as on-site transcripts, and simulate the case disposition process, including evidence collection and sanctioning procedures.

Pre-Class Accuracy Review. Following the supervision tasks, students were required to review and discuss their work processes, refine relevant documentation—such as case collegiality records, case reports, and penalty decisions—and compile reporting materials in preparation for classroom presentations.

Implementation of the FC. The classroom debriefing was conducted in four stages:

Group Debriefing and Experience Sharing: Each group designated a representative to report on task completion, while other members provided additional insights and responded to questions.

Student Critique and Discussion: Students from other groups evaluated the presenting group's

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performance, highlighting strengths and weaknesses, and posing questions for further reflection.

Table 1: Learning Task Card.

Serial No.	Task	Concrete content	Educational objective
1	Independent study based on learning resources provided by the teacher	Independent study using resources such as textbook content, extracurricular books (e.g. Review of Health Supervision Cases, Compendium of Health and Family Planning Laws and Regulations, etc.), teaching videos, teaching cases, online courses, and so on.	1) Knowledge Objective: To master the health laws and regulations in various fields and the main contents of health supervision. 2) Ability Objective: To develop health supervision skills, teamwork, communication skills, and the ability to identify and solve problems. 3) Emotional Objective: To understand the status quo and harm of health violations and to establish a sense of urgency and social responsibility through learning in a real field.
2	Learning case materials	Understand how to handle cases of violations in public places, medical institutions and other areas and the practical application of relevant laws and regulations.	
3	Carrying out health supervision in designated public places, medical institutions, etc.	Supervision and enforcement are carried out in designated public places, medical institutions and other places, and interrogation transcripts, on-site transcripts and supervisory opinions are completed. If problems are found, simulate the filing of a case, conduct investigation and evidence collection, and produce complete case materials.	
4	Classroom debriefing and experience sharing	Report on the completion of tasks through PPT, share the problems encountered in the supervision process, solutions, experience and skills and learning experience.	

Instructor Feedback and Guided Inquiry: The instructor provided feedback on student performance, addressed their questions, and encouraged deeper thinking through heuristic teaching strategies.

Assessment and Summary: The instructor graded each group based on predefined criteria, including task completion, communication skills, division of labor, mastery of professional knowledge, and critical thinking ability. Finally, the instructor summarized the key takeaways from the lesson.

2.4 Observation Indicators

2.4.1 Health Law Knowledge Test

A standardized health law knowledge test, independently designed for this study, was used to systematically assess students' mastery of legal knowledge. The test content was strictly based on current laws and regulations, comprehensively covering core legal norms, including the Regulations on the Management of Sanitation in Public Places, the Regulations on the Management of Medical Institutions, the Law of the People's Republic of China on Physicians, and the Law on Administrative Penalties. The test consisted of 50 standardized multiple-choice questions, each worth 2 points, for a total score of 100. The assessment focused on evaluating students' depth of understanding of health law knowledge.

2.4.2 Test on Theoretical Knowledge of Health Supervision

A final closed-book examination was administered to comprehensively assess students' mastery of the theoretical knowledge of health supervision through a diversified question format. The exam structure included multiple-choice questions, terminology explanations, short-answer questions, and case study questions, with a total score of 100. The assessment focused on evaluating students' depth of understanding of fundamental theories and their ability to construct a coherent knowledge system.

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2.4.3 Practical Skills Test for Health Supervision

The practical skills test primarily assessed students' proficiency in public health and medical hygiene supervision. The evaluation covered three key areas: identification of supervision indicators, detection of violations, and emergency response. The test was conducted orally, requiring students to accurately describe the supervision process, identify regulatory violations, and outline appropriate enforcement measures. This assessment aimed to evaluate their comprehensive practical skills in real-world scenarios. The total score for the test was set at 30 points.

2.4.4 Teaching Evaluation

A self-designed questionnaire was used to assess students' perceptions of the teaching process, and data collection was conducted via the Questionnaire Star platform. Both the control and experimental groups evaluated five key teaching dimensions: learning effectiveness (6 items), practical ability (6 items), interest in learning (6 items), collaborative ability (6 items), and approval of the teaching model (3 items). The questionnaire was based on a 5-point Likert scale, where 1 indicated “strongly disapprove” and 5 indicated “strongly approve”. Higher scores reflected greater teaching effectiveness. By comparing the responses of both groups, this study aimed to comprehensively assess the impact of different teaching models on students’ learning outcomes and overall skill development.

2.4.5 Feedback on open-ended questions

Collect specific suggestions and improvement opinions from students on the teaching model through open-ended questions.

2.5 Data Analysis

Statistical analysis was performed using SPSS 22.0 software. Measured data were expressed as mean ± standard deviation (M ± SD), and comparisons between groups were conducted using the independent sample t-test. $p < 0.05$ was considered statistically significant.

3. Results

3.1 Comparison of Learning Outcomes Between LBL and Integrated Teaching Models

The experimental group achieved significantly higher scores than the control group in both the health law knowledge test and the practical skills assessment in hygiene supervision ($p < 0.05$). However, no statistically significant difference was observed between the two groups in the final examination ($p > 0.05$). (Table 2)

Table 2: Comparison of scores between the control group and the experimental group ($\bar{X} \pm S$).

Group	Hygiene law knowledge test	Final exam	Hygiene supervision skills test
Control group(n=55)	76.36±4.89	77.03±9.72	23.07±3.01
Experimental group(n=55)	78.58±5.48	78.78±6.80	24.92±2.55
T-value	-2.24	-1.09	-3.49
P-value	0.027	0.278	0.001

3.2 Students' Evaluation of the LBL and Integrated Teaching Models

Table 3: Comparison of teaching evaluation between the control group and the experimental group.

Group Category	Control group(n=55)	Experimental group(n=55)	*t*-value	*p*-value
Learning effectiveness	24.96±4.51	26.73±3.70	-2.24	0.027
Practical ability	24.36±4.62	26.38±4.53	-2.31	0.023
Interest in learning	24.58±4.77	26.02±4.38	-1.64	0.103
Cooperative ability	24.96±4.32	26.40±4.08	-1.79	0.076
Recognition of teaching model	12.42±2.11	13.31±2.13	-2.20	0.030
Overall evaluation	111.29±19.35	118.84±17.95	-2.12	0.036

The results indicated that the experimental group scored significantly higher than the control group in learning effectiveness, practical ability, recognition of the teaching model, and overall evaluation

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score ($p< 0.05$). However, no statistically significant difference was observed between the two groups in learning interest and collaborative ability evaluation ($p > 0.05$). (Table 3)

3.3 Students' main suggestions and directions for optimization of the teaching model

In response to the feedback on the teaching model, students in the control group and the experimental group put forward different suggestions. (Table 4)

Table 4: Student suggestion form.

Group	Suggested content	number of people	ratio(%)
Control group(n=55)	1)Increase extracurricular practical opportunities to break through the limitations of classroom teaching	10	18.2
	2)Introduce more specific case studies to improve the practical application of knowledge	8	14.5
	3)Add role-playing and situational simulation law enforcement supervision activities to enhance the interactivity and experiential learning	7	12.7
	4)Other scattered suggestions or no suggestions	30	54.5
Experimental group(n=55)	1)Support the integrated teaching model and suggest adding extracurricular practical teaching activities	13	23.6
	2)Hope that teachers will be more deeply involved in student discussions and tasks to enhance teacher-student interaction	10	18.2
	3)Suggest adding group discussions and classroom debates to increase opportunities for personal presentations	12	21.8
	4)Other scattered suggestions or no suggestions	20	47.3

4. Discussion

4.1 The Integrated Teaching Model Enhances Mastery of Health Law Knowledge

This study demonstrates that the integrated teaching model effectively enhances preventive medicine students' mastery and application of health-related legal knowledge. Health supervision primarily targets preventive medicine professionals trained for health supervision agencies and serves as a critical mechanism for maintaining public health and social order. In professional practice, health inspectors must possess a comprehensive understanding of health laws, regulations, and standards before conducting supervision and enforcement activities. Their ability to apply legal knowledge to assess and regulate public health settings is a fundamental criterion for determining their professional competence[15]. However, traditional health law education primarily emphasizes theoretical instruction, often lacking practical application, which limits students' ability to effectively utilize legal knowledge in real-world scenarios[16]. In contrast, the integrated teaching model, which adopts a task-driven learning approach, immerses students in real-world tasks, stimulating their enthusiasm for learning and enhancing their analytical skills. Prior research has shown that task-based teaching positively influences learning motivation and engagement, ultimately improving learning outcomes[17]. In this study, students participated in on-site supervision and inspection tasks at supervised units, allowing them to physically experience real-world enforcement scenarios. The practical pressures of these environments motivated them to actively learn and apply hygiene law knowledge, particularly during the violation filing process, where students were required to correctly interpret and apply legal principles. This hands-on experience deepened their understanding of health laws while simultaneously challenging their communication, coordination, and on-the-spot decision-making skills. Research indicates that EL can reduce cognitive load, enabling students to engage more actively in the learning process, thereby improving comprehension and retention of knowledge[18]. Consistent with this, our findings show that the experimental group significantly outperformed the control group in the health law knowledge test, confirming the effectiveness of the integrated teaching model in enhancing legal knowledge application.

However, despite these advantages, it is important to note that while the experimental group

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excelled in the health law knowledge test, no statistically significant difference was observed between the two groups in the final theoretical knowledge examination. This discrepancy may be attributed to the differing emphases of assessment methods: the final exam primarily evaluates theoretical knowledge retention, whereas the integrated teaching model prioritizes knowledge application and practical skill development. Future research should explore strategies to balance theoretical memorization with the cultivation of practical application skills within this teaching framework, ensuring a more comprehensive learning experience.

4.2 The Integrated Teaching Model Enhances Students' Practical Abilities

Research indicates that the integrated teaching model significantly improves students' practical abilities in health supervision. The experimental group outperformed the control group in the health supervision skills test, demonstrating that this model effectively enhances students' ability to apply their knowledge in real-world scenarios. As a highly specialized and practice-oriented discipline, health supervision skills constitute a core assessment criterion in preventive medicine education. Specifically, practical competence in health supervision extends beyond legal knowledge acquisition and application to encompass professional inspection and evaluation (e.g., identifying health hazards), emergency response (e.g., conducting on-site investigations and managing public health emergencies), communication and coordination (e.g., effectively interacting with supervised entities), and regulatory documentation (e.g., drafting standardized supervision reports and penalty decisions). Many of these competencies fall into the domain of tacit knowledge, which is difficult to develop solely through traditional theoretical instruction and instead requires experiential learning in real-world contexts[19]. As Kolb's experiential learning theory emphasizes, "learning by doing" is fundamental to skill acquisition[20]. In alignment with this concept, our instructional design integrates TBEL with FC strategies to reinforce practical application. In this study, real-world scenarios were created through collaborations with external institutions (e.g., clinics and hotels). Students, working in groups, engaged in health supervision tasks, including site inspections, case handling, and documentation. This FC-driven knowledge internalization, combined with in-depth classroom discussions, formed a "theory-practice-reflection" learning cycle, significantly enhancing practical learning outcomes[21, 22]. According to Situated cognition theory, knowledge and skills acquired in specific social contexts are more effectively transferred and applied in professional practice[23]. Our findings support this theory, highlighting the effectiveness of the integrated teaching model in bridging the gap between theoretical learning and practical application.

4.3 The Integrated Teaching Model is Recognized by Students

A self-designed teaching evaluation questionnaire was used to compare and assess students' learning experiences under the integrated teaching model and LBL across multiple dimensions. The results indicate that students in the experimental group showed a higher level of recognition of the integrated teaching model, particularly in learning effectiveness and practical ability, suggesting that this approach effectively enhances both students' learning experiences and their overall competencies. Unlike LBL, which is typically teacher-centered, placing students in a passive learning state, the integrated teaching model engages students in task-driven learning, encouraging active participation. Under the guidance of instructors and peer collaboration, students demonstrated greater initiative, leading to higher levels of engagement and involvement. Pascarella's research suggests that active learning methods are approximately 10 percentile points more effective than passive learning approaches [24], which may explain why students in this study exhibited higher approval ratings for learning effectiveness and practical ability. However, despite the model's notable success in enhancing practical skills, it did not lead to a significant improvement in stimulating learning interest or fostering teamwork. One possible explanation is the extensive course workload and tight academic schedule, particularly for fourth-year preventive medicine students, who must concurrently manage multiple core courses, including health supervision, environmental hygiene, occupational hygiene, nutritional hygiene, epidemiology, and statistics. The limited time availability likely constrained opportunities for discussion, collaboration, and individual presentations, which in turn impacted students' learning motivation and communication skills. Reber R's research emphasizes that increasing interaction opportunities and providing a more personalized learning experience are crucial for enhancing student interest and engagement[25]. Based on these findings, future efforts should focus on optimizing curriculum design and scheduling to create a more balanced and structured learning process, ultimately improving students' overall learning experiences. Despite these challenges, the high overall rating given by the experimental group reflects strong student recognition and support for the integrated

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teaching model, underscoring its potential as an effective instructional approach.

4.4 Student Feedback Indicates the Need for More Teaching Practice and Presentation Opportunities

Student feedback suggests a strong demand for increased opportunities for hands-on practice and a platform to showcase their work. While the integrated teaching model has significantly improved students' practical abilities, it still falls short in providing sufficient practice opportunities and structured platforms for demonstrating their learning outcomes. Students have expressed interest in incorporating more extracurricular practical activities, case studies, role-playing exercises, and situational simulations to enhance the interactivity and experiential aspects of learning. This feedback serves as a valuable reference for future improvements in teaching design.

4.5 Limitations of the Current Study

Although this study has yielded meaningful findings, several limitations should be acknowledged. First, the sample size was relatively small and limited to preventive medicine students at Youjiang Medical University for Nationalities, which may not fully represent students from other institutions or disciplines. Second, the study duration was short, preventing a comprehensive assessment of the long-term impact of this teaching model on students' learning outcomes. Future research could address these limitations by expanding the sample size, extending the study period, and exploring the applicability of this model across different disciplines. Third, the assessment scales used in this study were primarily developed independently, which may limit their generalizability. Future research should incorporate more validated and targeted assessment tools to enhance the reliability and comprehensiveness of teaching evaluations. Additionally, this study relied predominantly on quantitative data, lacking qualitative insights from student interviews and in-depth reflections. Future studies could integrate qualitative research methods, such as student interviews and focus group discussions, to gain deeper insights into students' experiences and perceptions of the integrated teaching model.

5. Conclusion

This study confirmed the effectiveness of the integrated teaching model, which combines TBEL and the FC, in enhancing the teaching effectiveness of health supervision. The model significantly improved students' mastery of health law knowledge, strengthened their practical skills, and received high recognition from students. However, further refinements are needed to better stimulate learning interest and foster teamwork. In addition, the teaching model of this study has broad application potential. It is not only applicable to hygiene supervision courses, but also to other medical and public health related disciplines, such as occupational hygiene, environmental hygiene, and infectious disease prevention and control. Future research can further explore the applicability of this model in different colleges and universities and different majors to improve teaching effectiveness. This study provides a new perspective on medical education reform and a teaching model that can be used for highly practical course design.

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