SYNERGY PUBLISHING PTE. LTD.

Journal of Educational Theory and Management

https://ojs.s-p.sg/index.php/jetm

Exploration of a Three-Stage Blended Teaching Model for the Medical Microbiology Course in the Context of Smart Education

Li Liu* **Changzhi Li** **Bingjie Li** **Hongyan Gao**

Pingdingshan University, Pingdingshan, Henan, 467000, China

ARTICLE INFO

Article history

Received: 13 October 2024

Accepted: 17 October 2024

Published Online: 30 December 2024

Keywords:

Smart Education

Three-Stage Blended Teaching

Medical Microbiology

ABSTRACT

Objective: This study explores the effectiveness of a three-stage blended teaching model in the Medical Microbiology course for Clinical Medicine students within the context of smart education.

Methods: Clinical Medicine students from the 2021 and 2022 classes were studied, comparing the traditional and three-stage blended teaching models. Academic performance and survey feedback were analyzed.

Results: The research group's academic performance, including daily, final exam, and average scores, was significantly higher than the control group ($P < 0.05$). Over 95% of students approved of the new teaching model, noting improvements in competencies.

Conclusion: The three-stage blended teaching model effectively boosted student engagement, interaction, academic performance, and overall skills, showing potential for broader application in medical education.

1. Introduction

In recent years, China has made significant strides in advancing educational modernization, issuing policy documents such as the Education Informatization 2.0 Action Plan and China Education Modernization 2035. These documents emphasize the deep integration of information technology with education, charting a clear path for teaching reform in both basic and higher education[1,2]. As a driving force behind educational reform, smart education leverages intelligent teaching platforms, virtual laboratories, and other digital tools to provide more efficient teaching and learning experiences, significantly improving the quality of education[3]. In the field of higher education, where diverse student needs and society's demands for innovation and practical skills are increasing, blended teaching models have emerged as a key trend in educational innovation[4]. This model overcomes the limitations of traditional teaching in terms of time and space, fostering interaction and collaboration between teachers and students, enhancing students' self-directed learning and problem-solving skills, and laying the foundation for cultivating high-quality, application-oriented professionals.

Medical Microbiology, as a fundamental course in Clinical Medicine, plays a critical role in developing students' professional skills and competencies[5]. However, being a traditional morphology-based course, Medical Microbiology is content-heavy and conceptually abstract, making it difficult for traditional teaching methods to effectively engage students or facilitate deep knowledge assimilation[6]. With the rapid development of information technology and the growing popularity of smart education, the limitations of traditional teaching models

**Corresponding Author:*
Li Liu,
Female, Master,
Email: 3562@pdsu.edu.cn

 DOI: http://doi.org/10.12345/jetm.v8i4.20885

have become increasingly evident, no longer meeting the demands of modern medical education for cultivating innovative and practical talents[7]. Therefore, exploring and implementing a new teaching model that deeply integrates information technology and aligns with the principles of smart education has become a pressing issue in medical education today. The three-stage blended teaching model, built on the Learning Pass platform, follows a structured approach: "online knowledge acquisition, large-class skill training, and flipped classroom for innovative thinking." This model successfully integrates online and offline learning, offering a fresh perspective and method for the reform of Medical Microbiology education.

2. Materials and Methods

2.1 Study Participants

This study selected Clinical Medicine students from Pingdingshan University, specifically the 2021 and 2022 cohorts. A total of 60 students from the 2022 cohort formed the research group, while 59 students from the 2021 cohort comprised the control group. Baseline characteristics such as gender, age, origin, and entrance scores were compared, showing no statistically significant differences ($P > 0.05$), confirming comparability between the two groups.

2.2 Teaching Models

2.2.1 Grouping

The control group followed a traditional lecture-based teaching approach, while the research group utilized the three-stage blended teaching model. Both groups received 50 hours of theoretical instruction and 16 hours of laboratory practice. Continuous assessment (40%) and final exams (60%) were used for evaluation, including quizzes, classroom participation, assignments, and lab reports. To ensure consistency, both groups used the same textbooks and materials.

2.2.2 Optimization of Online Learning Resources

Given the rapid developments in microbiology due to emerging infectious diseases, the course content was updated to reflect the latest advances. Several innovations were implemented: ① **Micro-Lecture Videos:** Engaging videos were created to simplify complex microbiology concepts, utilizing high-quality visuals and animations to enhance understanding. ② **Clinical Case Studies:** Real-world case studies were integrated to bridge theory and practice, encouraging students to analyze case details and apply their microbiology knowledge to clinical problem-solving. ③ **Ideological and Political Education:** Relevant materials were incorporated to instill professional ethics, scientific thinking, and social responsibility within the curriculum. ④ **Comprehensive Online Resources:** The online course included clearly defined learning objectives, interactive videos, and multimedia tools, providing students with an immersive, multi-dimensional learning experience.

2.2.3 The Three-Stage Blended Teaching Model

The three-stage model was implemented as follows:

(1) Online Knowledge Acquisition

Before class, instructors meticulously design self-study task sheets with clear learning objectives to guide students in conducting efficient and organized self-learning. The online tasks include watching instructional videos, reading relevant literature, and completing exercises to help students build a solid foundational knowledge in microbiology.

① **Instructional Videos and Literature Review:** Students start by watching engaging instructional videos that present core microbiology concepts in a vivid and intuitive manner, helping them form an initial understanding. They then read relevant literature to expand their knowledge of the latest research advances and theoretical perspectives, strengthening their grasp of the subject's cutting-edge developments.

② **Interactive Feedback Mechanism:** During online learning, the platform provides features for real-time questioning and discussion, allowing students to interact with instructors and peers. This enhances student engagement. The course also includes online quizzes to assess learning effectiveness and identify knowledge gaps.

③ **Feedback and Personalized Guidance:** Quiz results serve as a tool for students to self-assess their progress and for instructors to adjust their teaching strategies. Teachers discuss common problems and offer personalized guidance for individual challenges, ensuring all students stay on track with their learning.

④ Post-Class In-Depth Learning: After class, students are encouraged to use platforms like "Learning Pass" to explore advanced topics in microbiology. Through reading the latest research findings and participating in instructor-led offline discussions, students deepen their understanding of the subject. This in-depth learning and reflection process not only ignites their interest in scientific research but also enhances their innovative thinking and practical skills.

By incorporating the online component of the three-stage blended teaching model, we effectively cultivate students' self-directed learning abilities, laying a solid theoretical foundation for their future scientific research and

DOI: http://doi.org/10.12345/jetm.v8i4.20885

clinical practice.

(2) Large-Class Teaching for Skill Development

The large-class teaching phase is based on the analysis of students' self-study progress before class, integrating interactive and practical activities to reinforce theoretical knowledge and improve clinical thinking and practical skills.

① **Mind Mapping and Multimedia Teaching:** In class, instructors use mind maps to systematically present complex knowledge systems, helping students build a clear and organized knowledge framework. By gradually expanding the mind map, instructors guide students to organize their thoughts and deepen their understanding. To address challenging topics, teachers employ visual aids and animations to illustrate abstract microbiological structures and pathogenic mechanisms, increasing classroom interactivity and engagement.

② **Clinical Case Analysis:** Instructors introduce representative clinical cases to strengthen the connection between theory and practice through group discussions and analyses. Students apply their knowledge to analyze pathogen characteristics, transmission routes, and pathogenic mechanisms, then explore appropriate treatment strategies. This group case discussion approach not only helps internalize knowledge but also fosters teamwork, communication skills, and clinical reasoning among students.

③ **Laboratory Skills Development:** Laboratory practice is a key component of large-class teaching and a crucial method for translating theoretical knowledge into practical skills. In the laboratory, instructors first demonstrate essential microbiological techniques, such as aseptic technique and streak plating. Students then practice these skills in groups, with instructors providing immediate feedback and guidance. Peer teaching further promotes mutual learning and improvement, enhancing students' practical abilities and their awareness of laboratory safety and scientific literacy.

Through large-class teaching, students reinforce their theoretical knowledge while significantly improving their practical skills and clinical thinking, laying a solid foundation for future clinical practice and research.

(3) Flipped Classroom for Innovative Innovation:

The flipped classroom, as the final stage of the three-stage blended teaching model, aims to cultivate critical thinking, innovation, and problem-solving abilities through active student participation and deep learning.

① **Pre-Class Preparation and Self-Study:** Instructors present relevant hot topics or clinical cases in medical microbiology, requiring students to conduct research and prepare initial viewpoints before class. This self-directed learning empowers students to explore the content and establishes a foundation for in-depth classroom discussions.

② **Classroom Presentation and Interaction:** During class, students take the lead by sharing their research findings and discussing their conclusions in groups. This active process of presenting significantly enhances knowledge internalization. Through presentations, students improve their communication skills while deepening their understanding and application of the material. Instructors and peers provide constructive feedback, challenge ideas, and pose questions, encouraging students to engage in deeper reflection and exploration.

③ **Instructor Guidance and Inspiration:** In the flipped classroom, instructors act as facilitators, posing thought-provoking, open-ended questions to inspire deeper student reflection. The design of guiding questions pushes students to move beyond superficial answers, encouraging them to analyze critically, question assumptions, and embrace innovative thinking.

④ **Team Collaboration and Idea Exchange:** The flipped classroom fosters communication and collaboration among students. Group discussions and interactions inspire students to exchange ideas and motivate one another, sparking collective growth and innovation. This cooperative learning environment nurtures teamwork and creative thinking, leading to the generation of innovative ideas.

By promoting active student participation and offering structured instructor guidance, the flipped classroom effectively deepens students' knowledge, enhances their ability to apply knowledge to real-world problems, and lays a solid foundation for future clinical practice and research innovation.

1.3 Evaluation of Effectiveness

The academic performance of both groups was assessed through means ± standard deviation and analyzed using SPSS 25.0 software. Independent samples *t*-tests were conducted, with a significance level set at $P < 0.05$. Additionally, student feedback was gathered via questionnaires and analyzed descriptively using percentages.

2 Results

The results indicated that the course grades of students in the research group were significantly higher than those in the control group (see Table 1), with a statistically significant difference ($P < 0.05$).

 DOI: http://doi.org/10.12345/jetm.v8i4.20885

Table 1. Comparison of Course Performance Between Groups

Group	*n*	Average Score ($\bar{x}\pm s$)	Regular Score ($\bar{x}\pm s$)	Final Exam Score($\bar{x}\pm s$)
Control Group	59	74.81±8.81	86.12±5.64	65.27±12.65
Research Group	60	78.64±6.47	88.60±4.55	72.00±10.73
t		-2.699	-2.642	-3.312
P		0.008*	0.009*	0.002*

*Note: *indicates $P < 0.05$.*

Following the implementation of the three-stage blended teaching model, a satisfaction survey was conducted among students in the research group. The results are as follows: Over 95% of students expressed satisfaction with the three-stage blended teaching model, highlighting its clear advantages over traditional teaching methods. 92% of students felt that this model enhanced their self-directed learning abilities and increased their interest in the subject. 92.5% of students reported that the three-stage blended teaching model encouraged active participation in classroom discussions, thus enhancing classroom interaction. 90% of students believed that this model helped them overcome knowledge gaps and improved their learning outcomes. More than 87% of students felt that this model contributed to the development of their clinical and innovative thinking skills.

3 Discussion

3.1 The Impact of the Three-Stage Blended Teaching Model on Learning Outcomes

This study successfully applied the three-stage blended teaching model-comprising online knowledge acquisition, large-class teaching for skill development, and flipped classroom for innovative thinking—using the Learning Pass smart education platform. The integration of online and offline learning offered new methods for the reform of the Medical Microbiology curriculum. In the online knowledge acquisition phase, students had access to multimedia resources, such as high-definition microbial images and 3D animations, which enhanced their engagement and improved comprehension of abstract concepts. This phase enabled self-directed learning, allowing students to learn at their own pace and establish a preliminary knowledge framework.

In the large-class teaching phase, interactive techniques like case analysis and laboratory practice were employed. These methods helped bridge the gap between theoretical knowledge and practical application, sparking interest and fostering critical thinking. Laboratory sessions provided hands-on experience, allowing students to translate theoretical concepts into essential microbiological skills. Additionally, teacher-student interaction was enhanced, promoting deeper learning through real-time feedback and discussion. This phase effectively developed students' clinical reasoning and practical skills, which are essential in their future medical practice.

3.2 Fostering Innovation and Collaboration through the Flipped Classroom

The flipped classroom phase allowed students to take a more active role in their learning. Through group discussions and project-based learning, students explored advanced topics in medical microbiology, proposed solutions to real-world challenges, and engaged in collaborative learning. This phase not only fostered innovation and problem-solving skills but also enhanced communication and teamwork-crucial competencies for medical professionals. The shift from a traditional teacher-centered model to a student-driven approach promoted critical thinking and deeper exploration of the subject matter.

Results from this study indicated that 92% of students believed the blended teaching model improved their self-directed learning abilities and increased their interest in the subject. Furthermore, over 87% of students reported that the model helped develop their clinical reasoning and innovative thinking skills. These findings highlight the model's capacity to motivate students and improve their learning experience. Additionally, 90% of students agreed that the model helped eliminate knowledge gaps, while statistical analysis showed that the research group significantly outperformed the control group ($P < 0.05$). This underscores the effectiveness of the model in transforming theoretical knowledge into practical application, aligning with the goals of smart education.

In conclusion, the three-stage blended teaching model demonstrated substantial effectiveness in improving teaching quality and developing students' comprehensive skills. Its emphasis on active, practice-oriented learning provides a promising framework for future medical education reforms. The success of this model in Medical Microbiology can offer valuable insights for other courses, contributing

DOI: http://doi.org/10.12345/jetm.v8i4.20885

to a more personalized and efficient learning experience in medical education.

4. Conclusion

The three-stage blended teaching model significantly enhanced the quality and effectiveness of the medical microbiology course, promoting student engagement and improving self-directed learning, practical skills, and innovation. This model has shown great potential for broader applications in other basic medical courses, offering valuable insights for education reform in clinical medicine. However, continuous refinement is necessary as we experiment and optimize teaching methods to better meet the evolving demands of smart education. With ongoing exploration, this model can foster higher-quality educational outcomes, contribute to scientific research, and strengthen the field of microbiology.

Funding Projects

Henan Province Medical Education Research Project (Exploration and Reform of the "Three-Fusion" Teaching Model for Medical Microbiology Courses under the New Medical Education Context, WJLX2024199); Teaching Reform Research Project of Pingdingshan University (Exploration of a Three-Stage Hybrid Teaching Model for Basic Medical Courses in Clinical Medicine under the Context of Smart Education, 2023-JY42); "Ideological and Political Education" Project for the "Medical Microbiology and Parasitology" Course at Pingdingshan University.

References

[1] Xu, J. Cheng. The Ministry of Education Issues the "Action Plan for Education Informatization 2.0" [J]. Information Technology Education in Primary and Secondary Schools, 2018, 0(5): 4-4.

[2] Lin, W., Wei, X., Liu, J. Accelerating the Deep Integration of Information Technology and Education Amid the Pandemic [J]. China Agricultural Education, 2020, 21(2): 15-1854.

[3] Li, L., Liu, H. Cultivating and Developing Teachers' Information-Based Teaching Competence in the Context of Smart Education: Insights from "New Explorations in Smart Education in the Era of Education Informatization 2.0" [J]. Chinese Journal of Education, 2021.

[4] Jiao, H. Shan, Li, D. Exploration of the "Three-Stage Mixed Teaching Model" in Human Cross-Sectional Anatomy [J]. Journal of Anatomy, 2021, 44(5): 458-460.

[5] Lan, T. Jin, Liang, L., Nong, Q., et al. Development and Exploration of a Student-Centered Hybrid Teaching Model for "Medical Microbiology" [J]. Technology Trends, 2024(12): 34-36.

[6] Sun, Y., Liu, G., Yang, B., et al. Exploring Online and Offline Hybrid Teaching Methods in Medical Microbiology Education [J]. Journal of Shenyang Medical University, 2024, 26(1): 104-107.

[7] Dang, L., Zhao, Z. Research on Paths to Enhance the Digital Teaching Competence of University Teachers in the Era of Smart Education [J]. Knowledge Economy, 2024(19): 229-231.

 DOI: http://doi.org/10.12345/jetm.v8i4.20885