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# Application of Micro-Lecture Combined with TBL Teaching in Physiology Experiment for International Students

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## Abstract

As medical education becomes increasingly internationalized, Yangtze University has seen continuous growth in its international student enrollment, with students from over 60 countries. Physiology experiment, a core course in basic medicine, faces challenges in teaching international students, including language barriers, cultural differences, and insufficient self-directed learning abilities. Micro-lectures and team-based learning (TBL) are two innovative teaching methods widely adopted in recent years. To improve teaching quality, we introduced a blended model combining micro-lectures with TBL and elaborated on its implementation in physiology experiment courses. The study is a single-cohort teaching reform evaluation with no control group. Questionnaire surveys and teaching evaluations show that this model was associated with positive student perceptions regarding learning interest, hands-on skills, and team collaboration spirit, and appeared to help mitigate difficulties caused by language and cultural gaps. Micro-lectures provide personalized learning, transforming the traditional pattern of "listening in class, practicing after class" into "listening before class, practicing in class". TBL promotes mutual learning and active participation. This model may offer a win-win outcome for both teachers and students, providing preliminary insights for reforming international medical experiment teaching.

## Keywords

Micro-Lecture, Team-Based Learning (TBL), International Student Education, Physiology Experiment, Yangtze University

## 1. Introduction

Physiology is a core course in basic medicine and presents both key content and

challenges in international medical education. Physiology experiment serves not only as a complement to theoretical teaching but also as a crucial link for cultivating students' practical abilities and scientific thinking [1]. The Health Science Center of Yangtze University began enrolling international students in 2010. After over a decade, international student enrollment continues to expand, with students from more than 60 countries. The clinical medicine program, a six-year curriculum, primarily attracts students from Pakistan, India, Nepal, Bangladesh, Tanzania, and several African countries.

However, international students face common problems such as limited Chinese proficiency, difficulty understanding specialized terminology, and significant cultural differences. Research shows that their academic foundations are uneven: Pakistani students often have weaker backgrounds in mathematics and physics, while African students have stronger foundations but different learning habits. Language barriers significantly affect classroom teaching effectiveness [2]. The traditional "teacher explanation, student imitation" approach rarely achieves good results; students tend to rely excessively on teachers to solve problems during operations, and learning stops once the experiment ends.

In recent years, micro-lectures and TBL have achieved positive results in international medical education [3] [4]. Micro-lectures are short online videos, typically around 10 minutes. TBL is a team-based method that emphasizes student self-directed learning [5]. Since 2018, the Department of Physiology at Yangtze University has explored a blended model combining micro-lectures and TBL for international students in physiology experiment courses. This paper summarizes the implementation methods and effects of this model, aiming to provide a reference for reforming international student experimental teaching.

## 2. Implementation Methods

Study design and participants: This single-cohort teaching reform evaluation included second-year international medical students (MBBS program) enrolled in the Fall 2025 Physiology Experiment course at Yangtze University. Inclusion criteria were: 1) full enrollment in the course, 2) completion of all teaching activities, and 3) voluntary participation in the post-course questionnaire. No students were excluded. A total of 98 students participated.

### 2.1. Design and Production of Micro-Lectures

Four key experiments were selected: "Factors Affecting Blood Coagulation in Rabbits", "Factors Affecting Arterial Blood Pressure in Rabbits", "Factors Affecting Respiration in Rabbits", and "Factors Affecting Urination in Rabbits". For each, we produced a micro-lecture video with Chinese-English bilingual subtitles. In the videos, the teacher performs operations while explaining in simple English, with concise language, clear structure, and emphasis on key and difficult points. Text, pictures, and animations were added during post-production to make the content intuitive and three-dimensional. Special attention was given to recording

operational segments of experimental observations and displaying expected results. Each video lasts 10 - 12 minutes and is uploaded to the campus network and the international student teaching platform. The Health Science Center has dedicated facilities for international students, including multimedia classrooms and experimental teaching spaces, allowing repeated after-class viewing.

### 2.2. Pre-Class Preparation and Grouping

Based on student characteristics, we divided students into heterogeneous groups by nationality, Chinese proficiency, and academic performance, with 5 - 6 students per group, ensuring each group has at least one student with strong English communication skills. Yangtze University requires international students in clinical medicine to achieve Level 4 of the Chinese Language Proficiency Scales (HSK Level 4) upon graduation, and applicants with HSK4 certificates or above are admitted preferentially. However, most students still use English for daily communication. Therefore, classroom and experimental teaching are conducted in full English or bilingual format.

Before class, micro-lecture videos and preview assignments are released through the platform, requiring students to master the experimental purpose, operational steps, and key terms. An English version of the experimental manual and a Chinese-English glossary of key terms is also provided. Students are notified and encouraged to preview the content before class to understand the surgical operations and observation items in advance.

### 2.3. Classroom Teaching Process (Using "Factors Affecting Arterial Blood Pressure in Rabbits" as an Example)

**Step 1: Team Operation (40 minutes)**—At the start of class, students divide roles within teams, including anesthesiologist, lead surgeon, and assistant. Through mutual learning and teaching among team members, students complete the entire experiment as independently as possible, including rabbit anesthesia, common carotid artery intubation, and various observation tasks. The teacher acts as a guide, promptly identifying difficulties and providing assistance.

**Step 2: Team Discussion (30 minutes)**—Teams draw lots to determine discussion questions related to the experiment, such as: What precautions are needed for rabbit anesthesia and common carotid artery intubation? What are the similarities and differences in cardiovascular effects caused by epinephrine and norepinephrine, and why? How does blood pressure change after clamping the other common carotid artery, and what is the mechanism of the baroreceptor reflex? Why do stimulating the central end and peripheral end of the vagus nerve produce different results? Each team selects a representative to present their discussion results in English, while another student provides supplementary comments. The teacher comments and follows up, and one or two students give a summary.

**Step 3: Teacher Summary (20 minutes)**—The teacher provides a final summary, including operational and knowledge components. The operational sum-

mary points out deficiencies in students' techniques, such as anesthetic dosage control and intravenous injection methods. The knowledge summary elaborates on theoretical principles from both neural and humoral regulation perspectives affecting the rabbit's cardiovascular system. Finally, each team submits an experimental report (written in English) and a peer evaluation form.

### 2.4. Assessment and Grading Rubric

Team score components were divided into three categories: team operation (30%), scored based on correctness of equipment setup (10%), adherence to experimental steps (10%), and safety compliance (10%); discussion presentation quality (30%), scored based on depth of analysis of experimental results (10%), accuracy of answering raised questions (10%), and ability to apply physiological principles (10%); and experimental report (40%), scored based on clarity and completeness (15%), data presentation and chart quality (15%), and interpretation and discussion of results (10%).Peer evaluation adjustment for individual grades: Each student rated their teammates on a 0 - 10 scale (anonymous). The individual peer rating was calculated as the average of other members' ratings. The individual grade was calculated as:

Individual grade = Team score × (Individual peer rating/Average team peer rating)

If a student's individual peer rating fell 20% or more below the average team peer rating, their individual grade will be set equal to the team score (no upward adjustment). This mechanism was designed to discourage free-riding while rewarding active contributors.

## 3. Evaluation of Implementation Effects

Questionnaire development: An eight-item questionnaire was self-developed and adapted from previously published instruments on blended learning and team-based learning in medical education [3] [4]. The draft was reviewed by three senior physiology educators for content validity, then piloted with 10 international students not in the study cohort. Minor wording adjustments were made based on pilot feedback. Reliability was assessed using Cronbach's alpha ($\alpha = 0.86$), indicating good internal consistency.

**Dimension definitions:** The questionnaire covered three dimensions: 1) **Recognition:** students' perceived usefulness of the micro-lecture + TBL model for understanding experimental procedures and concepts; 2) **Satisfaction:** students' satisfaction with the clarity of teaching content, bilingual subtitles, and integration of theory with experiments; 3) **Teaching inspiration:** students' perceived benefit of the model for developing clinical thinking, research ability, hands-on skills, and team collaboration spirit. The eight questionnaire items, covering the three dimensions described above, are presented in Table 1.

After the course, we conducted an anonymous questionnaire survey among 98 clinical medicine international students (mainly from Pakistan, India, Nepal, Bangladesh, Tanzania, etc.) who participated in this teaching model. The ques-

tionnaire included eight questions covering the three dimensions described above. Each question had four levels: "strongly agree", "agree", "disagree", and "strongly disagree". All 98 questionnaires were recovered (100% recovery rate, 100% validity).

Analysis method: Descriptive statistics (frequencies, percentages) were used. The agreement rate for each dimension was defined as the average percentage of students selecting "agree" or "strongly agree" across items within that dimension. No inferential statistical tests were performed. The full survey results are presented in Table 1 below.

Table 1. Student satisfaction and recognition survey results (N = 98).

| Item | Strongly agree n (%) | Agree n (%) | Disagree n (%) | Strongly disagree n (%) |
|---|---|---|---|---|
| 1. Micro-lecture videos convenient for repeated viewing | 48 (49.0%) | 41 (41.8%) | 7 (7.1%) | 2 (2.0%) |
| 2. Flexible preview improves learning initiative | 44 (44.9%) | 43 (43.9%) | 9 (9.2%) | 2 (2.0%) |
| 3. Group discussion enhances classroom participation | 52 (53.1%) | 39 (39.8%) | 5 (5.1%) | 2 (2.0%) |
| 4. Micro-lecture content concise, bilingual subtitles helpful | 39 (39.8%) | 48 (49.0%) | 9 (9.2%) | 2 (2.0%) |
| 5. Integration of experimental content with theory | 37 (37.8%) | 48 (49.0%) | 11 (11.2%) | 2 (2.0%) |
| 6. Cultivating clinical thinking ability | 35 (35.7%) | 48 (49.0%) | 13 (13.3%) | 2 (2.0%) |
| 7. Cultivating research quality and hands-on ability | 39 (39.8%) | 46 (46.9%) | 11 (11.2%) | 2 (2.0%) |
| 8. Cultivating team collaboration spirit | 50 (51.0%) | 39 (39.8%) | 7 (7.1%) | 2 (2.0%) |

Based on the data in Table 1, we calculated agreement rates (the proportion of students selecting either "agree" or "strongly agree") for each dimension. The results were as follows: Summary of agreement rates (agree + strongly agree): The recognition dimension showed rates of 90.8% (Item 1), 88.8% (Item 2), and 92.9% (Item 3). The satisfaction dimension showed rates of 88.8% (Item 4) and 86.7% (Item 5). The teaching inspiration dimension showed rates of 84.7% (Item 6), 86.7% (Item 7), and 90.8% (Item 8).

These results indicate that the majority of students held positive perceptions of the micro-lecture combined with TBL teaching model across all three dimensions.

International students responded positively. An Indian student said, "Micro-lectures can be watched repeatedly, so I'm not afraid of not understanding. Everyone does the experiment together in a group, which is more reassuring than doing it alone." A Pakistani student said, "I used to dare not operate, but because of the team division of labor, I can also try anesthesia."

Micro-lectures provide personalized learning, transforming the traditional pattern of "listening in class, practicing after class" into "listening before class, practicing in class", without being limited by class time. Students can take initiative and freely choose learning time and content. Teachers can organize classes more effectively and teach according to students' aptitudes. Combined with TBL, teacher-student and student-student communication are strengthened. Group learning enables advanced students to help those lagging behind, complementing

each other's strengths. Sufficient discussion time in class also deepens and broadens understanding.

## 4. Existing Problems and Countermeasures

Although this model achieved good results, some specific problems remain in international student teaching.

**Problem 1: Persistent language barriers.** Some international students are non-native English speakers (e.g., from French-speaking or African regions) with strong local accents and limited medical terminology. While micro-lectures provide flexible learning time, they also weaken teacher supervision. Some students do not watch micro-lectures or preview before class, nor review after class, leading to knowledge gaps. **Countermeasures:** Continuously solicit student feedback to improve micro-lecture quality. Encourage students to participate in micro-lecture production, which requires systematizing knowledge and gives students a sense of achievement. Drawing on cooperation experience with clinical teaching bases such as Jingzhou Second People's Hospital, arrange teaching assistants to provide real-time translation or keyword prompts. The school also uses stratified teaching strategies in the preparatory education system to provide differentiated language support.

**Problem 2: Uneven participation in discussion sessions.** In TBL experimental and discussion sessions, some students consistently engaged in hands-on tasks, while others remained passive observers or disengaged. This relates to lack of active learning attitudes and significant differences in learning habits. **Countermeasures:** Advocate role rotation across multiple experiments, with students taking turns performing various surgical operations. In discussion sessions, rotate the team leader and the presenting student each time, ensuring everyone has responsibilities. Adopt a "write before speaking within the group" approach (writing key points first, then stating them) to reduce language pressure.

**Problem 3: Uneven academic foundations.** International students come from different countries with significantly different educational backgrounds. In the 2025 Health Science Center postgraduate entrance interview, source countries included Pakistan, Canada, India, and Tanzania, with varying educational systems. Pakistani students have relatively weak math and physics foundations, while African students have stronger foundations but different learning habits [2]. This manifests in physiology experiments as some students struggling to understand mechanisms and principles. **Countermeasures:** Fully consider heterogeneity when grouping to achieve complementary advantages. Add supplementary explanation modules for basic knowledge in micro-lecture production for students with weak foundations to learn independently. The school can draw on stratified teaching strategies from the preparatory education system to provide personalized learning support.

## 5. Limitations

Several limitations should be acknowledged. First, this was a single-center study

with only 98 international students, which limits the generalizability of our findings. Second, the outcomes were based entirely on students' self-reported perceptions rather than objective measures such as exam scores or skill assessments. Third, the absence of a comparator group (e.g., traditional teaching or micro-lecture alone) prevents us from definitively attributing the observed learning gains to the blended model. Therefore, future research should test this model in other basic science courses, such as pharmacology or pathology, using a controlled design and incorporating objective learning outcomes.

## 6. Conclusions

The application of the micro-lecture combined with TBL teaching model in international student physiology experiment teaching fully utilizes the repeatability and visualization advantages of micro-lectures, compensating for teaching obstacles caused by language and cultural differences. Simultaneously, through TBL's team collaboration mechanism, it promotes mutual learning and active participation among international students. The questionnaire survey shows that this model was associated with positive student perceptions regarding learning interest, hands-on ability, and team collaboration spirit. We have conducted a new exploratory attempt of this blended model, which may offer mutual benefits for both teachers and students.

Currently, international student education at the Health Science Center of Yangtze University is moving toward high-quality development. The school continues to improve the preparatory education system for international students in China and promote the "Study at Yangtze University" brand. In 2025, the Health Science Center successfully completed a new round of postgraduate enrollment for international students while deepening cooperation with clinical teaching bases to build early clinical practice bridges. In the future, we will further optimize micro-lecture resources, improve the evaluation system, follow medical teaching reform trends, promote this model in more international student medical courses, and contribute to cultivating international medical talents who know and love China and possess excellent medical skills.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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