

# Comparison between the Blended Teaching Practice and Traditional Teaching of Pathophysiology Based on the Cultivation of Medical Thinking Ability

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## Abstract

In response to the development of medical education and the training of medical talents in China, the “Pathophysiology” course team of our school has been exploring the innovative blended teaching mode “oriented by cultivating the comprehensive thinking ability of medical students” from 2019 to 2021. The effect of blended teaching practice of Pathophysiology was compared with that of traditional teaching in 2018, and a retrospective analysis was carried out from the aspects of course performance, thinking ability training, and course satisfaction. The results showed that the course grades and students’ comprehensive thinking ability were gradually improved, the course satisfaction was greatly improved, and the teaching form was very popular among students. Blended teaching effect was better than traditional teaching, reflecting that the innovative blended teaching mode can better meet the learning needs of medical students and is conducive to professional ability development of medical students.

## Keywords

Pathophysiology, Blended Teaching, Online Teaching, Traditional Teaching, Medical Thinking Ability

## 1. Introduction

Pathophysiology is a basic medical discipline that studies the mechanisms and

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laws of functional and metabolic changes during the occurrence and development of diseases. Sun (2022) believed that it is an important bridge course to connect with clinical practice, and it is also one of the important subjects of the medical practitioner examination. Also Chai (2020) believed that this course focuses on cultivating medical students' comprehensive ability to solve complex medical problems and good clinical thinking ability. With the frequent occurrence of new diseases, the constant changes in the characteristics of disease spectrum, and the increasing demand for personalized diagnosis and treatment of patients, the course construction of Pathophysiology is faced with the severe challenge of how to effectively train medical students to transform knowledge into comprehensive analysis ability.

In recent years, Wang (2021) believed that the demand for medical education reform in China has continued to increase. On October 14, 2020, Wu Yan, director of the Department of Higher Education of the Ministry of Education, made it clear in the keynote report entitled "Seeking the overall situation to respond to the situation and opening a new situation-comprehensively promoting the innovation and development of medical education". Interpretation of "building a first-class medical curriculum, curriculum is the core element of talent training", it is urgent to cultivate medical talents with solid foundation, interdisciplinary and innovative ability based on curriculum system innovation.

Implementing the innovative construction of the "Pathophysiology" course, we continue to explore a new course teaching mode "oriented to cultivate the comprehensive thinking ability of medical students", and actively carry out three "online + offline, in-class + extra-curricular, basic + clinical" three dimensional blended teaching innovation practice. Zhang (2018) believed that using the advantages of MOOC helps to reshape teaching mode. At the end of 2018, the MOOC course "Pathophysiology" we built was launched on the MOOC platform of Chinese universities. In 2019, we began to implement an online and offline blended teaching mode. In 2020, due to the impact of the COVID-19 epidemic, we immediately adjusted to an online blended teaching mode. In 2021, we iteratively updated the original online and offline blended teaching mode to better reflect the "student-centered" curriculum innovation mode. These several practical experiences of teaching reform have provided valuable experience for the blended teaching reform of the "Pathophysiology" course in our school.

This paper compares the blended teaching data in 2019, 2020, and 2021 with the traditional teaching data in 2018, and makes a retrospective analysis from the aspects of course performance, thinking ability training, course satisfaction and students' subjective feelings. This paper analyzes the advantages and disadvantages of the teaching effect of traditional teaching and blended teaching, and analyzes the existing problems, so as to provide a theoretical basis for further optimizing the teaching mode of "Pathophysiology", in order to better achieve the goal of curriculum construction and establish professional golden courses.

## 2. Research Subjects and Methods

### 2.1. The Research Subjects

Select the grade 2016, 2017, 2018, and 2019 Stomatological medical students of Taikang Medical School, Wuhan University (School of Basic Medical Sciences, Wuhan University) as the research subjects. Each grade covers 5, 5 + 3, and 8 years students, with a total of 331 students.

### 2.2. Teaching Implementation

The “Pathophysiology” course is open to second-year medical students. Students in the above four grades respectively studied this course in the first half of 2018, 2019, 2020, 2021, and the teaching team was the same. In 2018, this course was basically in the traditional teaching mode, mainly in classroom teaching, with a total of 32 hours, and it is set as the traditional group. In 2019, this course carried out an online and offline blended teaching mode, which is set as an online/offline blended group. Online teaching relies on the MOOC platform of China University and the LuoJia online platform of Wuhan University. The MOOC resources cover the content of textbooks and topic sections such as interviews with famous doctors, research progress, and doctor-patient interaction. Students conducted online self-study before class to familiarize themselves with basic knowledge points and clinical medical records. The offline classroom teaching was 32 hours. In the way of threading clinical medical records, teachers talked about the pathogenesis of diseases, sorted out important and difficult knowledge, and combined group discussions and flipped classrooms, guided students to discuss the multi-facetedness and complexity of diseases from book knowledge combined with clinical medical records, and analyzed the theoretical basis for disease prevention and treatment. After class, students were guided to learn online to expand their knowledge, read literature, and make mind maps. In the first half of 2020, due to the impact of the COVID-19 epidemic, [Yang \(2020\)](#) reported that all students were studying at home. This course was adjusted to an online blended teaching group and set up as an online blended group. The online teaching design is the same as in 2019. The offline classroom teaching was adjusted to the online SPOC live teaching (32 hours), and the final exam adopted the online electronic test paper. In 2021, we iteratively updated on the basis of the original online and offline blended teaching mode, and set it as an online/offline blended group (2nd generation). In addition to further expanding online MOOC resources, we also strengthened the analysis of medical records and group discussions in offline classroom teaching, and carried out offline expansion of classroom learning and practice. The class attendance rate of the students in this course was 100%. From 2019 to 2021, the completion rate of students participating in online MOOC reached 100%.

### 2.3. The Evaluation Method of Teaching Effect

The overall evaluation of the course consists of: final exam paper scores, online

MOOC scores (not available in 2018), formative evaluation scores of discussion class, and after-class assignments scores. From 2019 to 2021, the proportion of course grades was continuously adjusted, gradually reducing the proportion of final exam papers, and increasing the proportion of other sub-items, so as to promote teaching improvement and guide students to change their learning behavior.

To collect and analyze the grade data for all the research subjects, to compare the total score and the average score of each sub-item under different teaching modes in the 2018-2021 academic year; course evaluation and questionnaire survey were carried out for all research subjects, and the course satisfaction and learning experience of different teaching modes were evaluated. 245 feedbacks and 320 valid questionnaires were collected from students.

## 2.4. Statistical Methods

Measurement data were described as mean  $\pm$  standard deviation, and student's *t* test was used for comparison between groups. For categorical data, the chi-square test was used to judge the differences between groups, and the Cochran-Armitage trend test was used to analyze the significance of the trend changes in multiple groups. Statistical analysis was done in R software (<https://www.r-project.org/>). Differences were considered statistically significant at  $P < 0.05$ .

## 3. Analysis of the Teaching Effect of Different Teaching Modes

### 3.1. Performance Analysis

Compared with the traditional teaching group in 2018, the 2019-2021 blended teaching group has more difficulty in sub-assessments such as final exam papers, discussion class medical records, and after-class assignments, and it focuses more on assessing students' thinking on medical issues ability.

**Table 1** shows the average scores of the general assessment scores and sub-item scores of the "Pathophysiology" course in each academic year. In terms of the overall evaluation scores and final exam papers, the scores of the online/offline blended group in 2019 were lower than those of the traditional group in 2018 (statistics,  $P = 0.027$ ,  $P = 0.0093$ ), and the scores of the online blended group in 2020 were higher than those of the traditional group in 2018 (statistics,  $P < 0.0001$ ,  $P < 0.0001$ ), the 2021 online/offline blended group (2nd generation) is higher than the 2018 traditional group in terms of overall evaluation (statistics,  $P = 0.0108$ ).

This shows that the overall learning effect of the blended teaching innovation can be better than that of the traditional teaching group after exploration and optimization.

Further compare the scores of basic knowledge questions and ability analysis questions in the final exam papers of each academic year (**Table 2**). Basic knowledge

**Table 1.** Comparison of the average scores of the “Pathophysiology” course in each academic year.

teaching academic year	exam number	overall evaluation	final exam paper	online MOOC	formative evaluation of discussion class	after-class assignments
2018 (traditional)	84	82.3 ± 8.5	78.6 ± 10.3	/	87.0 ± 7.7	94.0 ± 5.7
2019 (online/offline blended)	86	78.3 ± 14.5*	73.5 ± 14.7**	93.4 ± 15.3	88.0 ± 10.7	94.3 ± 11.8
2020 (online blended)	83	87.5 ± 4.9***	84.9 ± 6.5***	96.2 ± 5.0	87.1 ± 4.2	93.0 ± 4.1
2021 (online/offline blended, 2nd generation)	78	85.5 ± 7.0*	80.5 ± 9.6	95.4 ± 1.8	88.7 ± 3.7	95.1 ± 2.5

Note: All grades are expressed as percentages, and statistical descriptions are made as mean ± standard deviation; with the grades in 2018 as the control, the differences in grades in other years are compared, and the statistical significance is accordingly. \* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ ; “/” means “none”.

**Table 2.** The correct score of the ability analysis questions of the “Pathophysiology” test paper in each academic year.

teaching academic year	Basic knowledge questions (%)	Ability Analysis Questions (%)
2018 (traditional)	80.1 (77.5 - 82.5)	41.7 (38.6 - 44.8)
2019 (online/offline blended)	73.1 (70.2 - 75.8)	75.9 (73.1 - 78.5)
2020 (online blended)	86.3 (84.0 - 88.4)	77.9 (75.2 - 80.4)
2021 (online/offline blended, 2nd generation)	79.2 (76.6 - 81.7)	84.6 (82.2 - 86.8)

Note: The 95% confidence interval of the score rate is indicated in brackets.

questions include noun explanation, A1-type multiple-choice questions, B1-type multiple-choice questions, short-answer questions, etc. Ability analysis questions include A2-type multiple-choice questions, comprehensive case analysis questions. Compared with the traditional teaching group in 2018, the final exam papers of the 2019-2021 blended teaching groups have increased the number and scores of the ability analysis questions year by year. These measures are more focused on the comprehensive analysis ability assessment of medical students. The scores of the 2018-2021 ability analysis questions are 4, 10, 24 and 24 points respectively (the total score of the test paper is 100 points).

Comparing the scores of basic knowledge questions, the traditional group in 2018 had a correct score of 80.1%, which was higher than that of the online/offline blended group in 2019 (73.1%) and 2021 (79.2%) respectively, reflecting that traditional teaching still has certain advantages for students to master basic knowledge. In 2020, the scoring rate of basic knowledge questions in the online blended group was as high as 86.3%, which may be related to the reduction of other forms of learning activities during the COVID-19 pandemic, and students spent more time reviewing book knowledge.

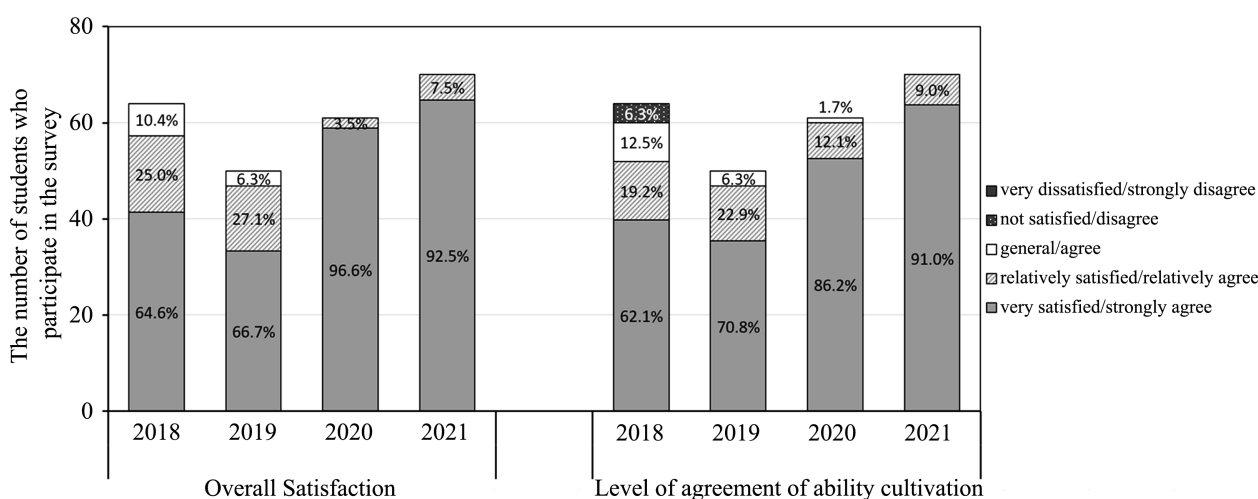
Comparing the scores of ability analysis questions, the correct rate of the traditional group in 2018 was only 41.7%, while from 2019 to 2021; the score rate of the blended teaching group increased year by year, 75.9%, 77.9% and 84.6% respectively, which was significantly higher than that in 2018. It reflects the students' ability to solve complex medical problems has been significantly enhanced.

### 3.2. Course Evaluation

After the course is over, we obtained feedback on students' satisfaction with the course through the school evaluation system.

From 2018 to 2021, for the survey question "I am objective, truthful and responsible for the overall satisfaction of the course without considering academic performance", the students who expressed very satisfied and relatively satisfied in turn reached 89.6% (64.6% and 25%), 93.8% (66.7% and 27.1%), 100% (96.55% and 3.45%), 100% (92.5% and 7.5%), reflecting that the students' satisfaction with the course has increased year by year (test statistic for trend,  $P = 0.001215$ ), which indicates that compared with the traditional teaching mode in 2018, the blended teaching mode is widely welcomed and highly evaluated by students.

From 2018 to 2021, for the survey questions "This course has cultivated my innovative thinking ability and ability to analyze and solve problems" students who strongly agree and relatively agree reached 81.3% (62.1% and 19.2%), 93.7% (70.8% and 22.9%), 98.3% (86.2% and 12.1%), and 100% (91.0% and 9.0%) respectively. It reflects that students' recognition of the innovative thinking ability of this course increases year by year (trend test statistic,  $P = 9.0E-6$ ), indicating that the blended teaching mode is more conducive to the cultivation of students' comprehensive thinking ability (Figure 1).



**Figure 1.** The overall satisfaction and ability cultivation agreement of the course evaluation of Pathophysiology in each academic year (the column labels show the percentage of students who chose the corresponding option to the total number of students surveyed).

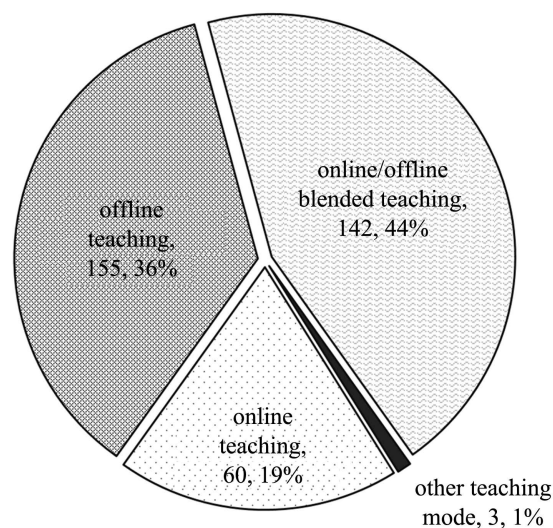
### 3.3. Survey on Students' Favorite Teaching Mode

We conducted a questionnaire survey: "According to the learning experience of basic medical courses, which teaching mode do you like best?" As shown in **Figure 2**, 44% (142/320) of the students prefer the online/offline blended teaching mode, 36% (115/320) of the students prefer the offline teaching mode, and only 19% (60/320) of the students prefer the pure online teaching mode.

### 4. Conclusion and Reflection

Our school's "Pathophysiology" course is aimed at the second-year medical students. In terms of study habits, the students are network aboriginals and are accustomed to the integration of media and the transmission of large amounts of information. **Teng (2020)** believed that they are eager for teachers to use network information technology to improve learning interest and meets the needs of individualized learning. At the level of mastery of medical professional knowledge, students have completed the study of basic medical theories such as anatomy, physiology and biochemistry, **Li (2016)** believed that the knowledge reserve of students is fragmented. They couldn't completely analyze the overall impact of the etiology on the body and the causal link of the corresponding clinical symptoms. According to the outstanding problems in students' learning habits and mastery of medical professional knowledge, we gradually established the curriculum reform concept of "cultivating medical students' comprehensive thinking ability as the guidance", carried out a series of innovative teaching measures of blended curriculum, and continued to iterate and optimize in the implementation process.

Analyzing the teaching effects of different teaching modes, it is found that the innovative practice of blended teaching has been explored and iteratively optimized for three years from 2019 to 2021, the overall teaching effect is better than the traditional teaching group.



**Figure 2.** Survey results of students' preference for different teaching modes.

In the cultivation of medical students' comprehensive analysis ability, the blended teaching mode is obviously superior to the traditional teaching mode. [Chen \(2018\)](#) believed that ability assessment questions such as A2-type multiple-choice questions (case summary-type best multiple-choice questions) and case analysis questions can effectively test students' ability to analyze, judge, and solve complex medical problems. Compared with the traditional teaching in 2018, The scoring rate of ability assessment questions of the blended teaching group has increased significantly from 41.7% (2018) to 84.6% (2021), reflecting the students' enhanced ability to solve complex medical problems. Students' recognition of "This course has cultivated my innovative thinking ability and ability to analyze and solve problems" has also increased year by year, and the students who expressed strong agreement and relative agreement have increased from 81.3% (2018) to 100% (2021), indicating that blended teaching effectively cultivates the comprehensive thinking ability of medical students. [Goodman \(2018\)](#) believes that "student-centered" learning is significant in medical teaching, which is reflected in the innovative effect of blended teaching, which provides us with full confidence to continue to promote curriculum innovation and reform.

The traditional teaching mode still has certain advantages for medical students to master basic knowledge, which suggests that we need to use the advantages of various teaching modes, learn from each other's strengths, and take into account the mastery of basic knowledge and the cultivation of thinking ability while carrying out the innovation of blended teaching.

Online blended teaching was an emergency teaching mode we adopted in response to the COVID-19 outbreak in 2020. Compared with the online and offline blended teaching mode (2019, 2021), its teaching effect was comparable, and the students' satisfaction with the course was also very high, indicating that the online teaching mode we implemented has withstood the difficulties of teaching at that time and ensured learning effect.

So, can online teaching mode replace the online and offline blended teaching mode? The questionnaire shows that compared with pure online teaching, students are more inclined to choose online and offline blended teaching and offline teaching, which shows that students still have a high demand for offline classroom learning. The offline classroom has the advantage of face-to-face communication, which helps students improve their learning concentration, facilitates students to carry out flipped classrooms and group discussions, and also facilitates teachers to give timely guidance and feedback on students' learning. Therefore, the online and offline blended teaching mode is more suitable for students' study habits and needs.

In a word, the innovative blended teaching mode implemented by the "Pathophysiology" course in our school has achieved remarkable teaching effect through iterative optimization, and has been widely welcomed and highly appraised by students. In the future medical curriculum reform and innovative practice, we will aim at cultivating medical talents of "five arts", keep pace with



the times, and constantly explore the medical education mode that adapts to the future.

### **Ethics Approval and Consent to Participate**

The project was approved by the Human Research Ethics Committee at the Wuhan University. Students were informed about the study and signed consent forms.

### **Availability of Data and Materials**

The dataset used and/or analysed during the current study is available from the corresponding author on reasonable request.

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### **Conflicts of Interest**

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

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