Application of Flipped Classroom in Biochemistry Teaching Reform at Basic Medicine College Based on PBL and Multimedia Technology

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Abstract. To cultivate high-quality medical talents, given the problems in the biochemistry teaching at basic medicine colleges, a flipped classroom teaching model is established based on PBL and multimedia technology through WeChat public platform and virtual simulation experiment platform, to improve the enthusiasm of students in learning, improve the teaching effect, and blaze a new trail for the reform of medical experimental education.

Keywords: Biochemistry, Experimental Teaching, Flipped Classroom Based on PBL

1. Introduction
Biochemistry is an essential compulsory course that explores the essence of life phenomena from the molecular level at medical colleges. It is also a crucial link for medical majors to connect basic medical theoretical knowledge and clinical courses[1-3]. With the improvement of living standards, computers, smartphones, and networks have changed the way people communicate and offered new opportunities for the development of education[3]. The application of the Internet to educational reform is required for the development of the times. Biochemistry is now a compulsory basic course for many majors in comprehensive colleges and medical colleges[4-5]. The biochemistry teaching at basic medicine colleges is an integral part of the biochemistry course, which is irreplaceable, the ability to use theoretical knowledge to solve practical problems, scientific research literacy, innovation awareness, etc. With the continuous development of the modern medical education concept, increasing attention has been paid to the establishment of a student-centered teaching model[6]. Based on the core concept of PBL and flipped classroom, this paper constructs a new teaching model to make a preliminary exploration of the biochemistry teaching at basic medical colleges.
2. Problems in biochemistry teaching at basic medicine colleges

In the traditional biochemistry teaching model, teachers are in the central position, where they teach the purpose, principle, content, operation method, and precautions of this experiment in class. Students are in a passive place, where learning and thinking are rigid and superficial. When they encounter problems, they can't think independently but rely on teachers excessively. They can only complete the experiment mechanically and fail to absorb the knowledge truly. In the past, it fell into a vicious circle of boring classrooms and students who lost interest in studying. Only by establishing a teaching mode with students as the main body and thoroughly stimulating students' enthusiasm and initiative in the learning process, can the teaching effect be improved.

Due to the large scale of medical students to be trained and the limited teaching resources, and class hours such as school construction funds and laboratory space, many experimental technologies that have been extensively used in scientific research laboratories, such as Western blotting, real-time quantitative PCR, cannot be performed in the undergraduate experimental teaching. In addition, the hands-on opportunity of every student cannot be guaranteed even if the experiment can be performed. Hence, high-quality experimental teaching cannot be accomplished.

3. Feasibility of flipped classroom application based on pbl to biochemistry teaching at basic medicine colleges

PBL teaching method is a problem-oriented, student-centered approach based on group discussion. This teaching model can significantly improve the enthusiasm and initiative of students' independent learning.

Biochemistry teaching in basic medicine college mainly enables students to master the separation, purification, content determination, and other experimental approaches for proteins, enzymes, sugars, nucleic acids, and other biological macromolecules. Each experimental class has a distinct theme. Compared with the traditional model, the theoretical knowledge points are less and easier to integrate. Hence, it won't increase the learning load of students.

WeChat is the most powerful instant messaging software on social networks in recent years and has become an indispensable tool for college students to learn in life. As a function module derived from WeChat, WeChat public platform can release video, pictures, words, etc. WeChat public platform is used to establish a biochemical experimental learning platform, and teachers can bring learning resources into the platform; students can do it anytime and anywhere fragmented learning improves learning interest and efficiency, providing a convenient platform for self-directed learning.

Our university has independently developed an independent learning platform for virtual simulation experiments. Students can conduct virtual simulation experiment in the virtual environment and in the interface of human-computer interaction, with important significance for training students' practical operation ability.

In summary, according to the teaching objectives of biochemical experiments, we take WeChat public platform and virtual simulation self-directed learning platform as the “carrier”, combine PBL teaching method with flipped classroom teaching model, with complementary advantages, to build a flipped classroom teaching mode based on PBL, which is feasible and necessary to be applied in the biochemistry teaching at basic medicine colleges.
4. Implementation process of flipped classroom based on pbl in biochemistry teaching at basic medicine colleges

Based on the teaching objectives and contents, teachers prepare enough learning resources such as teaching videos, PPTs and PBL task lists for students. The teaching videos are short and exquisite, with a duration of 5-10 min. PBL task list guides students to master key knowledge points and experiments through problem-oriented excercise steps. For example, in the separation of hemoglobin and DNP-chymotrypsin by gel column chromatography, PBL task sheet is as follows: What is the meaning of G value of dextran gel? Why should we keep water on the gel bed? What is the purpose of controlling the dripping speed when the sample is separated? The teachers release the teaching materials to the students through the WeChat public platform 1-2 weeks in advance so that students can learn for themselves.

Before class, students are assigned to experimental groups (4-5 students) and take turns to serve as the group leader. Through the learning materials released by teachers on WeChat public platform, they can also retrieve and consult relevant materials, combined with virtual simulation:

$$\text{Min cost} = \sum_{i=1}^{n} \text{cost}(r_i)$$

s.t. \( RE \geq RE_0 \), \( 0.5 < r_i < 1 \), \( RE_0 = 0.9 \). \( \text{(1)} \)

Based on the equation (2), the expected reliability of the system can reach 0.9, and the reliability of each component meets the minimum cost on the premise of 0.5 to 1. The constraint equation is added to the objective function as a state transition matrix term, which becomes an unconstrained optimization problem, namely:

$$\text{Min cost} + \text{penalty} = \sum_{i=1}^{n} \text{cost}(r_i) + k \cdot \min \{0, RE - RE_0 \}$$

\( \text{(2)} \)

Where \( k \) is a sufficiently large negative number. Hence, if the minimum reliability value of the system is not satisfied, the state transition matrix is inversely proportional to \( RE - RE_0 \).

In general, in the model with the minimum cost as the optimization objective, the functional relationship between the cost and the reliability of each component is very important. The reliability cost relationship function based on experience and/or data is shown in equation (3):

$$c_i(R_i; f_i, R_i,_{\max}) = e^{(1-f_i) \frac{R_i - R_i,_{\min}}{R_i,_{\max} - R_i}}$$

\( \text{(3)} \)

The flipped classroom based on PBL is a new teaching mode, which is the product of the combination of modern information technology and education. When it is applied in the biochemistry teaching of basic medicine college, it has received good teaching effect, given students full freedom of learning, stimulated students' interest in learning, improved students' ability of teamwork, language expression, independent learning, lifelong learning, which is an inevitable requirement with the
development of the times.

5. Cases and result analysis

The test paper is given out for the chapters of flipped classroom teaching content, which is distributed to the traditional class and the trial class of food biotechnology specialty in a secondary vocational school at the same time. The results are shown in Table 1.

Table 1. Test results of traditional class and pilot class

| class         | Number | Maximum value | minimum value | mean value | standard deviation | variance | Difference test (SIG. Value) |
|---------------|--------|---------------|---------------|------------|--------------------|---------|-----------------------------|
| Traditional class | 35     | 87            | 47            | 68.26      | 10.93              | 120.64  | 0.25                        |
| Trial class   | 36     | 98            | 52            | 75.44      | 11.83              | 140.14  |                             |

The above table shows that the average score of the trial class is higher than that of the traditional class. However, the analysis results of the independent sample show that t-test, SIG. = 0.25, which is greater than 0.05. The reasons are as follows: The flipped classroom teaching has not been implemented for long (only for a month), and the implementation effect is not fully reflected. The results of the performance test cannot show the advantages of flipped classroom teaching. The scores of the test paper are divided into five grades: Fail (0-60), pass (60-70), medium (70-80), good (80-90), excellent (90-100). The scores of the traditional class and the pilot class are calculated, and the differences between the two classes are shown in Figure 1 as follows.

Figure 1. Performance comparison between the pilot class and the traditional class

Figure 1 shows that after the pilot PBL-based flipping class, the number of students who failed in the pilot class decreased significantly, the middle students and the excellent students were much more than the original class, and the rate of excellence was obviously higher with the original classroom teaching. Hence, the implementation of flipped classroom teaching practice is conducive to improving students' overall knowledge mastery, deepening students' understanding of knowledge, improving the performance of excellent students and helping the students with a pass or below step into the rank with medium and excellent performance. Compared with the traditional teaching mode, students are more
active, more willing to interact in the classroom, creating a high rate of excellence.

6. Conclusions
The rapid development of science and technology has brought unprecedented opportunities and challenges to teaching at colleges and universities. Through the practical exploration of WeChat assisted case teaching method, the “PBL” teaching method is applied to biochemistry teaching practice, which combines the mysterious and rigid biochemistry theoretical knowledge with scientific research and clinical practice to exert the initiative of students in learning. It can deepen the students' understanding of theoretical knowledge and exploration of disease development mechanism and cultivate their scientific research thinking and clinical practice capabilities. Hence, it is of substantially significance to promote the innovation of the biochemical teaching approach, increase teachers' professional level and curriculum teaching quality, and improve students' self-learning capabilities. As a supplement to the conventional teaching approach, “PBL” teaching method is suitable for promotion in clinical medicine education at colleges and universities.

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References
[1] Park, S. E. , & Howell, T. H. . (2015). Implementation of a flipped classroom educational model in a predoctoral dental course. Journal of dental education, 79(5), 563-570.
[2] Rose, E. , Claudius, I. , Tabatabai, R. , Kearl, L. . , & Jhun, P. . (2016). The flipped classroom in emergency medicine using online videos with interpolated questions. Journal of Emergency Medicine, 51(3), 284-291.
[3] Schneider, A. , Michael Kühl, & Susanne J Kühl. (2019). Utilizing research findings in medical education: the testing effect within a flipped/inverted biochemistry classroom. Medical Teacher, 1-7.
[4] Mcdonald, K. , & Smith, C. M. . (2013). The flipped classroom for professional development: part i. benefits and strategies. The Journal of Continuing Education in Nursing, 44(10), 437-438.
[5] Girgis, F. , & Miller, J. P. . (2017). Implementation of a “flipped classroom” for neurosurgery resident education. The Canadian journal of neurological sciences. Le journal canadien des sciences neurologiques, 45(1), 1-7.
[6] Kevin Ahern. (2016). Teaching biochemistry online at oregon state university. Biochemistry & Molecular Biology Education, 45(1), 25-30.