



## **Application Research of Flipped Classroom Teaching Model based on MOOC in the Course of Biochemistry Teaching**

**Xingli Zhang\*, Congping Tan\*, Ding Feng\***

School of Food Science and Engineering, Qilu University of Technology (Shandong Academy of Sciences), Jinan, China, 250353

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**Abstract:** Flipped classroom teaching model based on MOOC is the development trend of higher education and also the development direction of university education teaching reform in the future. Flipped classroom and MOOC breaks through the typical limitations of traditional classroom and truly embodies the educational concept of "student-centered". Biochemistry is a very important core course in biology, food science, pharmacy and other related to majors. The teaching content is complex and abstract, and the class time is relative less. Therefore, it is of great significance to use the flipped classroom teaching model in biochemistry teaching. Based on the practice of biochemistry teaching in recent years, this paper expounds the application of flipped classroom in biochemistry teaching.

**Keywords:** MOOC; Ipped Classroom; Biochemistry

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Massive open online courses (MOOC) originated in the US in 2007<sup>[1]</sup>. In 2012, America's top universities (Harvard, MIT) and rapidly emerging providers (Coursera, Udacity, edX) offered free courses online, making systematic learning possible for more students<sup>[2]</sup>. In 2013, MOOC swept through the Chinese education sector. Peking University, Tsinghua University and other universities successively signed contracts with America's MOOC platform and opened 15 online courses to the world for free. 2013 is also known as the first year of MOOC in China. In May 2014, "Icourse" and "netease cloud classroom" jointly launched a MOOC platform with independent intellectual property rights -- Chinese university MOOC. Since then, MOOC has gained rapid development in China. Currently, famous MOOC platforms include Chinese University MOOC, "Xuetang" Online, "Good University" online, "Wisdom Tree" MOOC and "Super Star" MOOC in China. By 2019, The number and scale of MOOCs in China has reached the top in the world. Due to the sudden outbreak of COVID-19 at the beginning of 2020, students could not go to school and teachers could not teach face-to-face, many teachers chose MOOC of various platforms to complete the teaching task. MOOCs played a very important role in the realization of "teaching and learning without going to school" in colleges and universities.

With the rapid development of information technology and the emergence of MOOC and "micro class", flipped classroom<sup>[3]</sup> emerges as the times require, which is a new blended teaching mode combining information technology with classroom teaching model. In the class, teachers change traditional knowledge imparting to learning guidance and guide, and students change passive knowledge absorption to active participants in the teaching process. Teachers can discuss relevant knowledge points with students, and give differentiated and personalized guidance to individual students in the class. Flipped classroom breaks through the typical limitations of traditional classroom and embodies the educational concept of "student-centered". Flipped classroom is conducive to stimulating students' learning interest and autonomous learning ability, thus improving the teaching quality. Under this mode, teachers can complete the prescribed teaching tasks with fewer class hours and achieve better teaching results. In short, MOOC and flipped classroom teaching mode is one of the most emerging education and teaching modes, a general trend of future education development, as well as a reform of teaching mode, which paid close attention to by educational researchers around the world.

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Biochemistry is one of the fastest developing and most dynamic frontier disciplines in biological science and related fields, it is also a very important core course for biology, food science, pharmacy and other majors. Learning this basic course well, it is of great significance for students to learn professional course and scientific research in the future. However, the contents of biochemistry are complex, abstract and difficult to understand with relatively few class hours. The students were intimidated by the learning biochemistry. Therefore, it is of great significance to adopt MOOC-based flipped classroom teaching mode in biochemistry teaching [4]. This article clarifies that flip classroom teaching mode based on MOOC was applied in biochemistry teaching from four aspects: the change of teaching ideas, resource construction, implementation of the flipped classroom, and the optimization of evaluation systems. Through this kind of teaching pattern, students were to further stimulate interest in learning, improve the autonomous learning ability, innovation consciousness and spirit of unity and cooperation, to achieve the purpose of improving the teaching quality and teaching effect.

## **1. Changing the teaching idea**

### **1.1 Sticking to “strengthening moral education and cultivating people” and improving the moral cultivation of teachers**

In the report to the 18th National Congress of the CPC, it was pointed out for the first time that "strengthen moral education and cultivate people" [5] is the fundamental task of education, and the purpose of education is to train builders and successors of socialism. It not only points out the fundamental task of higher education, but also points out the development direction of education and teaching reform.

The connotation of "strengthen moral education" is to cultivate and practice the socialist core values, carry forward the excellent traditional culture of the Chinese nation, carry out the cultivation of humanistic quality and so on, so as to improve students' national pride and self-confidence. The meaning of "cultivating people" is to cultivate students' noble moral sentiment, solid scientific knowledge and cultural quality, and a healthy body and mind, emphasizes to make students have the Chinese culture, the common ideal of socialism with Chinese characteristics and international vision, to become qualified builders and reliable successors of socialism.

The moral cultivation of teachers directly affects the cultivation of students' world outlook, outlook on life and values, and determines the quality of talent cultivation in colleges and universities. Teachers' words and deeds have a direct impact on students' behavior, so we must first strengthen teachers' ethics education.

### **1.2 Adhering to teaching philosophy of the “student-centered” and “teacher-led”**

Adhere to the student-centered [6] teaching concept, the student is the main part of the study, under the guidance of teachers need timely, fully mobilize students' subjective initiative, play a strong knowledge foundation and the advantage of self-learning ability, to ensure smooth and efficient to complete the teaching activities, causes the student to obtain knowledge, ability, and the development of intelligence and literacy, and achieve the teaching goal. The leading role of teachers is objective and necessary. Teachers decide and design the teaching plan, teaching content, teaching process, teaching result and teaching quality evaluation method in advance. In addition, modern educational thoughts and concepts such as quality education and personalized education should be permeated throughout the teaching process. Highlight the cutting-edge content of the course, and focus on cultivating students' scientific research ability and innovative spirit.

## **2. Constructing course resources and improving students' interest in learning**

### **2.1 Revising syllabus**

According to the requirements of the training program and the characteristics of flipped classroom teaching mode, the teaching outline is revised, which further clarifies the knowledge point that students should master, difficulties and key points, the curriculum objectives of biochemistry and the support of the curriculum objectives for graduation requirements.

## 2.2 Setting curriculum goal

According to the revised syllabus and engineering certification requirements, the team members formulated the knowledge aim, capability goal and quality target of biochemistry:

### 2.2.1 Knowledge aim

a)The students should master the structural characteristics, physical and chemical properties and basic metabolic processes of sugars, lipids, proteins, nucleic acids, enzymes, vitamins and other molecules related to metabolism of the body.

b)The students should be familiar with the relationship between substance metabolism and body function; The flow of information and the regulation of gene expression revealed by the center laws of genetics.

### 2.2.2 Capability goal

a)The students should master the basic principles of biochemical experiments, proficient in centrifugation, spectrophotometry, electrophoresis, titration and other biochemical experimental methods and skills.

b)The students should learn to observe experimental phenomena scientifically, record experimental results correctly, analyze experimental data reasonably, and master the correct writing method of experimental reports. Cultivate the ability to observe, analyze and solve problems comprehensively.

### 2.2.3 Quality target

a)The students should have a certain sense of scientific research, scientific and rigorous working attitude and realistic working style.

b)The students should possess the basic knowledge and skills of biochemistry required for further study.

c)The students should have independent learning ability, innovation ability and spirit of solidarity and cooperation.

## 2.3 Online open course construction

### a)Course video construction

Biochemistry teachers in Qilu university of technology choose zhihuishu.mooc as online open course platform. According to biochemistry teaching outline, teaching target, teaching content, and the professional characteristics, they recorded nearly 850 minutes of video, which contains the complete knowledge point, the length of time is between 5-15 min. Video was upload to the platform for students to watch and learn. In 2018, biochemistry Open Online Course was recommended as the first online course of Shandong Curriculum Alliance. In addition, teachers also select high-quality teaching resources from other platforms for students to learn by themselves. Abundant teaching resources and perfect “zhihuishu” platform provide necessary hardware conditions for teaching team members to implement flipped classroom.

### b)Question bank construction

According to the teaching goal and the importance of chapters, biochemistry teachers finished nearly 1500 questions for students. No less than 150 questions were collected in the important chapters, such as proteins, enzymes, biological oxidation, glucose metabolism, lipid metabolism, protein metabolism, while no less than 50 in other chapters. All the problems would be uploaded to the “zhihuishu” platform and established the question bank, which has implemented to make up the examination paper random, to ensure that each student encountered different items in chapter tests and the learning process, and to prevent individual student to plagiarism unconsciously.

## 3. Implementing flipped classroom and improving classroom teaching effect

Flipped classroom is a part of classroom teaching, which serves a certain part of the classroom or some teaching activities.

### 3.1 Careful preparation and scientific design.

Before class, teachers make learning plans according to the teaching syllabus and teaching objectives, and release learning tasks through the “zhihuishu” platform, QQ group or WeChat group.

The students can arrange their own time freely to watch the course video and complete the preset exercises. When the students encounter problems, they can online consult with teachers in the discussion zone of “zhihuishu” platform,

QQ group and WeChat group, each student can ask or answer questions on other students and participate in the discussion.

When students watching the video, bullet questions were set to prevent them from doing others thing. If the question is not solved, the page will stop at the place where the "bullet questions" appear. After students finished each chapter of the course video, they need to complete online chapter quizzes. According to the teaching content, teachers set the objective questions with different number which mainly inspect the basic knowledge. "zhihuishu" platform can automatically mark paper. The students who are not satisfied with test scores can apply for to redo, repeat three times, and choose highest test scores as the final grade.

### **3.2 Creating reasonable situations and implementing flipped classroom teaching activities**

Flipped classroom includes several parts: pre-class review, testing, classroom teaching and summary.

Review: Take a few minutes to review what students learned in the previous class.

Test: in order to understand and test the student to teacher the learning task and video posted by the knowledge of the situation, with "rain class" or "zhihuishu" platform the students are tested, you can use the single topic selection, multiple choice and vote, the platform will automatically record right or wrong data of the students, through the analysis of the large data about students mastery of knowledge, thus provides the teachers on the basis of knowledge.

Classroom activities: the teacher can set up different situations according to the teaching content to improve students' interest in learning. For example, when they teach sugar chemistry, can lead to ABO blood group from blood transfusion, the blood group antigen on the blood group specificity depends mainly on the red cell membrane of sugar chain, and then analyze whether blood donation is a hazard, the necessity and importance of blood donation, blood donors for the society dedication of love, at the same time improve their health, also carried on the "investment" for self-health. The teachers encourage students to donate blood gratis, which improved the students' social sense of responsibility and humanistic quality.

Class summary: At the end of the class, the teacher will summarize the teaching content of the class, not only summarizing the difficult points and key knowledge, but also analyzing and summarizing the problems encountered by students in learning.

In the whole teaching process, teachers no longer play the role of imparting knowledge, but play the role of guidance and guidance. They can give differentiated and personalized guidance to students at different level. And students are no longer passive recipients, to be fully mobilized to participate in the teaching process. In flipped classroom, students' problems can be solved timely and information can be fed back quickly, thus to complet the internalization of knowledge and achieve better teaching effect.

## **4. Optimizing the teaching evaluation system and improve the teaching effect**

The MOOC-based flipped classroom teaching model is very different from the traditional teaching model, and the evaluation system is also different from the traditional way. Whether MOOC or flipped classroom, the teaching effect is more suitable for process evaluation. However, the traditional evaluation system focuses on the summative evaluation. Therefore, the evaluation system adopts the combination of process evaluation and summative evaluation, paying attention to the assessment of students' independent learning ability on the one hand, and the assessment of students' theoretical knowledge mastery on the other hand.

Students' final grade consists of two parts: online score accounts for 40%; the offline achievement accounts for 60%, and the proportion of each item is shown in table 1. Online interaction mainly involves students using MOOCs to study, asking questions online and answering questions from other students. Classroom performance refers to the performance of interaction and discussion with teachers or other students in class. The online final examination adopts objective questions and "zhihuishu" platform can automatically mark paper, which mainly assesses the students' mastery of basic knowledge. The offline final exam uses subjective questions for the closed-book examination, which mainly examines students' ability to analyze and solve problems. Both evaluating the ability of independent learning and evaluating the mastery of knowledge reflects the authenticity and objectivity of flipped classroom based on MOOC.

Tab.1 Composition of total score

Total score (100)						
Online score (40%)				Offline score (60%)		
Video and learning habit	Chapter test	Online performance	online final exam	assignment	Classroom performance	offline final exam
34%	16%	20%	30%	10%	20%	70%

## 5. Conclusion

Biochemistry is the core course of biology, food science, pharmacy and other majors. It is also one of the disciplines with the fastest development and most vitality in natural science. It not only has a strong theoretical basis, but also has a strong practicality. Flipped classroom not only brings vitality to biochemistry teaching reform, but also brings opportunities and challenges to teachers. The effective teaching strategy of flipped classroom is the important task and goal of university teachers' continuing teaching reform. With the rapid development of educational informatization in China, flipped classroom based on MOOC will have a more profound impact on the reform of biochemistry teaching.

Corresponding author: Zhang Xing-li, female, 1971.05, Qilu University of Technology (Shandong Academy of Sciences), School of Food Science and Engineering; Ph. D., associate professor; Research direction: biochemistry, E mail: xlzhang227@163.com

## Foundation projects

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2. Construction Project of Core Curriculum Group of Qilu University of Technology (40012712)

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