



RESEARCH ARTICLE

ASSESSMENT OF TEACHING EFFECTIVENESS IN A FLIPPED BIOCHEMISTRY COURSE COMBINED WITH SCHOOL-ENTERPRISE COOPERATION

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Manuscript Info

Manuscript History

Received: 07 May 2024

Final Accepted: 14 June 2024

Published: July 2024

Key words:-

School, enterprises
Cooperation, Teaching
Effectiveness, Flipped Classroom
Biochemistry

Abstract

The new curriculum standard proposes that teachers and students should exchange positions, students as the teaching subjects and teachers guiding students to learn independently. This requirement is consistent with the flipped classroom model. In this study, learning gains based on school-enterprise cooperation were assessed in a flipped biochemistry course. The study demonstrates this teaching model cultivates students' self-learning ability, enhances their learning enthusiasm, improves the teaching quality of biochemistry.

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Introduction:-

The undergraduate of life science, need comprehensive ability, innovation ability and the preliminary scientific thought. School-enterprise cooperation is an important way to promote the transformation of these undergraduate. The biochemistry, as an important practical course linked with the actual social, has been useful in attracting science graduates of high calibre, in providing them with a sound laboratory-based training and stimulating their interest in following a career in life science. School-enterprise cooperation had a far-reaching impact on the biochemistry course [1].

The flipped classroom has become an increasingly popular pedagogical approach to teaching and learning. As classroom teaching is the main form of teaching organization and activity way, and is also the main base on the classroom teaching mode reform. So, on the basis of our own situation of bioscience teaching, we go a little deeper into the objective of bioscience teaching [2].

School-enterprise cooperation is a talent training mode combining educational activities with social production practice [3]. At present, the lack of motivation for enterprises to participate in school-enterprise cooperation and the resulting problem of "school hot and enterprise cold" seriously limit the talent training quality in China's application-oriented universities. There is an urgent need to explore the influencing factors and mechanisms of enterprises' participation in school-enterprise cooperation to improve the training quality of applied talents [4].

Course Design

The sophomore biochemistry course at College of Life Science in Shanxi Normal University is taught only one semester. In the fall of 2023, Participation of students came from two classes of biochemistry, one class was taught as a traditional lecture while the other was taught as a flipped classroom combined with school-enterprise cooperation. Classes were taught in back-to-back time periods by the same instructor.

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Course assessment measures were identical in both classes, the only difference was how lectures were presented and how time was spent in class. In the traditional classroom, students received a 90 minute lecture that used a combination of powerpoint images. On occasion the class read assigned research articles and then worked in small groups to answer questions about the work as it related to the course material. For flipped classroom, teachers can discuss with enterprises to extract the key and difficult points in the textbook and practice, and send them to students through the Chaoxing Learning App for free online discussion. Students in the flipped classroom were asked to view the key and difficult points before class and come to class prepared to work on these key and difficult points in small assigned groups.

Course statistic

The traditional class had 41 enrolled students and the flipped class combined with school-enterprise cooperation had 40 enrolled students. All study participants completed midterm exam and post-test, and a survey.

Table 1:- Statistic for study participants.

Participants (N)	Sophomore	Female	Male
Traditional	41	38	3
Flipped	40	36	4

Assessment of Learning Gains

Midterm exam and a cumulative final were administered to two classes. Both the traditional and flipped classrooms performed nearly identically on two exams. Exam class averages were within standard error of each other on every exam when compared between traditional and flipped classrooms (Table 2).

Table 2:- The exam grades compared.

Participants (N)	midterm exam (SD)	Final Exam (SD)
Traditional	85.89±11.37	82.38±12.37
Flipped	87.27±14.56	84.50±15.37

Two exams were given over the course of term. (SD= Standard Deviation).

A survey of learning gain was administered at the end of term. Students were asked to assess their own perception of learning gains and acquired skills in 10 areas (Tables 3). Only two learning gain areas exhibited a significant difference in means between flipped and traditional classrooms ($p=0.04, 0.02$), thus students in the flipped classroom were more able of theory with practice after taking the course than the traditional students. The students in the flipped classroom spent considerably more time working in small groups and therefore perceive that their skill in cooperative learning had improved.

Table 3:- Survey results of learning gain.

question	class	5	4	3	2	1	mean	P
Understanding elementary knowledge	T	10	26	5	0	0	4.1	0.39
	F	20	16	4	0	0	4.4	
Understanding the nature of biochemistry	T	5	26	6	3	1	4.4	0.12
	F	9	25	4	1	1	4.0	
Understanding cooperative group learning	T	5	10	20	5	1	3.2	0.04
	F	20	15	5	0	0	4.4	
Ability of theory with practice	T	6	11	14	10	0	3.3	0.02
	F	14	13	12	1	0	4	
Confidence in your ability to do biochemistry	T	5	7	21	6	2	3.2	0.23
	F	10	9	17	3	1	3.6	
Feeling comfortable with complex ideas	T	5	10	20	5	1	3.9	0.58
	F	20	15	5	0	0	4.4	
Enthusiasm for biochemistry	T	8	10	12	7	3	3.2	0.33
	F	11	11	14	3	1	3.7	
Lectures (in-class)	T	18	10	13	0	0	4.1	0.45
	F	22	14	4	0	0	4.5	
Online Chaoxing Learning	T	30	10	1	0	0	4.7	

App	F	25	10	5	0	0	4.5	0.39
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(5= "I gained a great deal", 4 = "I gained a lot", 3= "I gained somewhat", 2 = "I gained a little", and 1 = "I gained nothing/not at all").

Discussion:-

At the beginning of the flipped classroom, teachers can invite exemplary individual from relevant enterprises to explain the knowledge of this lesson in the classroom, impart relevant practical experience, discuss difficult problems with students, complete experimental operations, let students interact and connect with enterprises, and enhance their practical experience. After the course ends, teachers can lead students to visit enterprises, and arrange excellent students to practice and learn in enterprises. They can apply the knowledge learned in the classroom to practice, providing a platform for students to transform the knowledge learned. Through practice, it can be found that compared with traditional classrooms, the advantages of reverse classrooms are mainly reflected in the following aspects: using this method can stimulate students' learning enthusiasm, make them study hard, and lay a good foundation for their future work, which is very beneficial for the development of related enterprises and even society[5].

In order to achieve flipped biochemistry classroom teaching, teachers need to implement online and offline teaching. Online, teachers can send course knowledge points to application groups, and there are relevant enterprise workers in the group. Based on understanding the knowledge points, students can discuss problems with teachers and enterprise workers in the group, solve their misunderstandings. This model can achieve the goal of improving classroom teaching efficiency, allowing teachers to use limited classroom time to complete the set teaching goals and tasks to the maximum extent. At the same time, students can also download relevant test questions in the application to test their understanding of the knowledge, clarify the content that needs to be learned and mastered, and make targeted adjustments to the learning plan based on this. Offline, teachers can conduct classroom teaching in the form of MOOCs, micro lessons, group discussions, and other forms[6]. After teachers ask questions about the content of the lesson, students discuss and solve problems within the group. When students are unable to solve problems, teachers should guide them, allowing them to solve problems on their own, deepen their knowledge impression and understanding of the article. In flipped biochemistry classrooms, teachers play the role of "guides", and students, as the main body of the classroom, occupy a dominant position in the learning process. Afterwards, during the experimental operation, teachers can invite relevant experts from enterprises to lead students in the operation. For example, when conducting the "Amylase Activity Determination" experiment, students should strictly follow the relevant experimental regulations. Experts should guide students in experimental operations, and teachers should act as classroom assistants to help students solve operational difficulties in the experiment, complete each step of the experimental operation in a standardized manner. During the experiment, experts can explain practical cases related to this experiment to stimulate students' interest in learning, thereby improving the teaching quality and efficiency of this course[7].

Conventional learning of biochemistry requires memorization of a huge amount of material. However, with the school-enterprise cooperation, we need to re-evaluate what we require life science students to memorize and focus on teaching them how to conceptualize, critically assess. This will enable the students to remember essential biochemical principles. Under the school-enterprise cooperation model, teachers should focus on talent cultivation and combine theory with practice in teaching. Teachers should use flipped classroom teaching methods to enhance students' interest in learning, familiarize themselves with the entire textbook content, and understand its content, reconstruct and identify the key and difficult teaching content, and create a micro lesson video to allow students to understand the content of this lesson before class[8]. For example, when learning "Vitamins", teachers can extract the definition, classification, physiological functions, deficiencies, and other knowledge of vitamins in this chapter, create a micro lesson video of about 8 minutes, and upload it to the learning group of this course in the Chaoxing Learning App for students to watch, so that students can master the basic knowledge points of this unit, identify areas they do not understand, and discuss them in the discussion area; For areas that are difficult to understand, students can engage in class discussions after the teacher has explained the knowledge points, in order to deepen their understanding and impression of the content of this lesson[9].

Conclusion:-

By flipped classrooms and school-enterprise cooperation, teachers could focus on students and provide them with a good learning environment to promote their comprehensive development, as teaching the relevant content of biochemistry[10].

Funding

The study was supported by thereform of postgraduate teaching foundation of ShanxiProvince (J20230607).

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