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Application and Implementation of Flipped Classroom in College Chemistry Teaching under the OBE Concept

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Abstract: *With the progress of the times, school education has undergone significant changes compared to the past. In schools, the form of "micro classes" can be used to establish a "flipped classroom", which is conducive to students' autonomous learning. In general, a micro lesson is composed of a teaching video, which is the core content that students must learn. It eliminates a large number of useless knowledge points, which is a new method that can enable students to learn efficiently. The 'flipped classroom' breaks through the limitation of 'not being able to learn too much in the classroom'. This would enable students to take the initiative in their learning and achieve the goal of learning anytime and anywhere.*

Keywords: *College Chemistry Teaching, Flipped Classroom, OBE Concept, Application and Implementation*

1. Introduction

With the advent of the information age, the use of flipped classrooms has become more widespread, and there has been a significant improvement in depth and breadth. China is also adapting to the actual needs of the new curriculum reform by combining this teaching method with thematic teaching links. Through relevant experimental investigations, some scholars only focus on theory when analyzing and researching flipped classrooms, without providing guidance and basis for relevant practice, resulting in a very limited role of flipped classrooms. In addition, some universities in Shanghai and Guangdong have also attempted to "flip the classroom", but their teaching effectiveness and quality is not satisfactory.

A large number of scholars have proposed relevant research on the application of flipped classrooms. Turan Z consulted a full-text database on education, including Web of Science, Eric, Taylor&Francis, and EBSCO, and analyzed a total of 43 articles. A systematic review was used in the research method. The content analysis method was used to analyze these articles. The research results show that the most commonly used research methods in flipped classrooms in English teaching are mixed and quantitative methods. Among the studies examined, speaking and writing abilities were the most commonly studied language skills. Further analysis shows that using flipped classroom methods in English as a foreign language classroom poses both challenges and benefits [1]. Mandasari B described the implementation of the flipped classroom learning model and analyzed its impact on students' satisfaction with grammar classes. This study was conducted at the Technical University of Indonesia. The participants in the study were 48 students from the English education learning program who registered for intermediate classes. The data was obtained through observation, questionnaires, and interviews [2]. In order to maintain teaching and learning amidst the disruption of traditional teaching, most universities have adopted an online teaching model. Most universities adopt an online teaching model. The purpose of the study is to investigate the effectiveness of various online teaching modes and compare a proposed model that combines online and flipped learning with other online and traditional modes. It designed a learning questionnaire under COVID-19 and conducted a survey on undergraduate students [3]. The above research proposes the integration of different knowledge in flipped classrooms, but few scholars have combined flipped classrooms with chemistry.

The concept of "flipped classroom" is a typical teaching model of "student-centered". A professor from a university said, 'Flipped classrooms are a better teaching method and a way of' learning before

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teaching '; Compared to the traditional guidance method of learning first and teaching later, micro video learning has more activity and can be used as a substitute for teachers' knowledge explanation; And when students encounter problems or confusion in their learning, they would receive help from the teacher, which is called flipped classroom This article would soon discuss the application and implementation of flipped classroom under the OBE concept in university chemistry teaching, demonstrating the significant improvement of flipped classroom learning efficiency in chemistry classrooms.

2. College Chemistry Teaching, OBE Concept, and Flipped Classroom

2.1. OBE Concept

The Connotation of OBE Concept

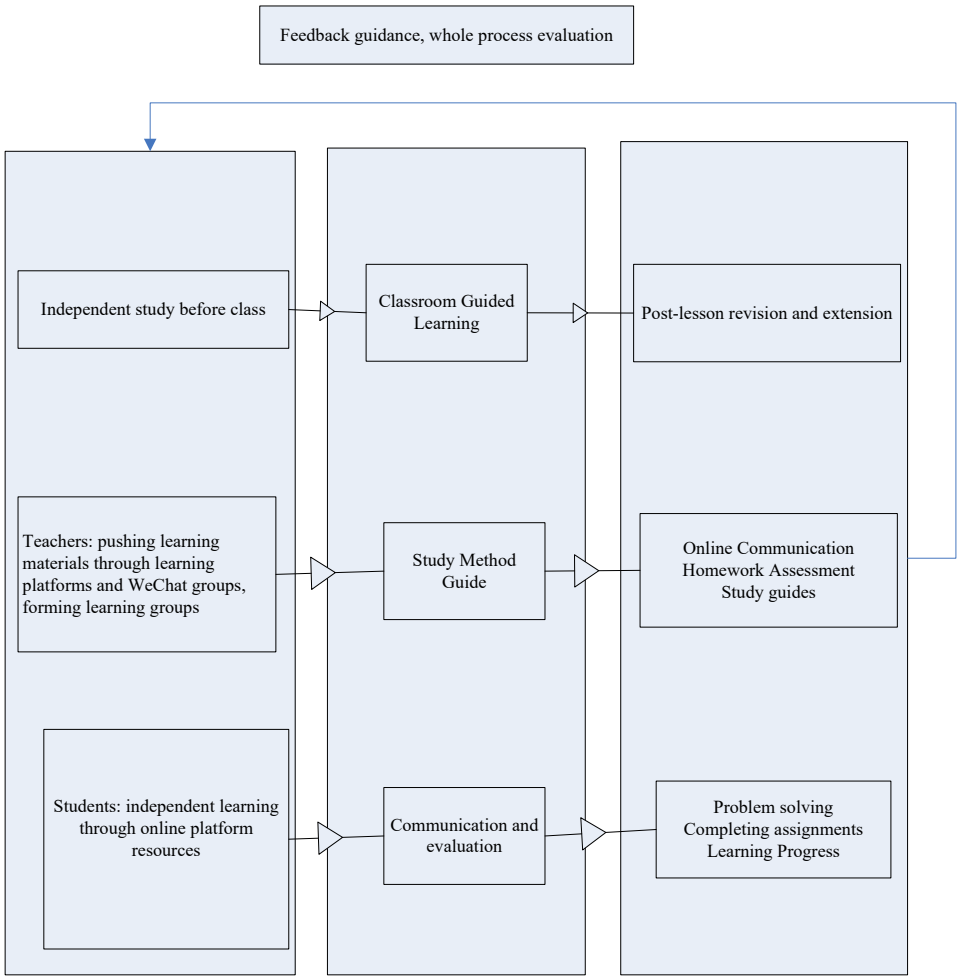

Figure 1: Teaching mode of flipped classroom

The OBE ideology is a teaching model of "educational reconstruction", emphasizing the core of students' ability output, evaluating them according to corresponding standards, and using the evaluation results as a main indicator to measure the level of education. This concept initially emphasizes the verifiability of knowledge, which means that after systematic training, students can use reasoning, argumentation, experimentation, or examples to determine whether the knowledge they have learned is correct. The focus of educational output would be on measurable student learning outcomes, rather than the number of library collections, classroom area, and teacher tenure, making it closely related to educational quality and accountability. This concept later evolved into a "learning method", requiring teachers to provide reverse guidance and guide students' process learning based on their ability and knowledge to meet the standards of student output [4].

Knowledge is not only the basic content of education, but also the main carrier of education. In higher education institutions, students should not only have comprehensive specialized knowledge, but

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also have general knowledge in humanities and natural sciences. Ability emphasizes the development of individual potential, physical health, intellectual development, and technological advancement. From the perspective of measurement standards for teaching quality, it is necessary to focus on students' ability to analyze, solve problems, hands-on, and creative thinking [5].

The traditional education concept focuses on the process of cultivation, only focusing on the amount of education investment, without paying attention to the results, let alone the knowledge and abilities that students actually acquire. Under the guidance of this concept, a teaching method without a clear purpose has been formed, which makes students and even teachers unaware of how to do it, which greatly affects the effectiveness of training. As time goes by, this traditional talent cultivation philosophy that overlooks the purpose and effectiveness of learning must be changed. The new trend of university education is to "people-oriented", emphasizing the cultivation of core abilities of "people" and promoting comprehensive development of people [6]. In learning, students are the internal cause and subject, while teachers are the external cause and auxiliary. Only by fully utilizing students' subjective initiative can the best learning results be achieved. The education model based on outcome based education (OBE) clarifies students' ultimate learning goal from the beginning - to cultivate their comprehensive ability to adapt to future society, ensuring that students have a clear understanding of what they need to learn and how to effectively achieve their goals, thereby stimulating learning interest from within and outside. Teachers can also teach based on the expected final learning outcomes of students, helping them master the ability to adapt to society and cope with the future, and achieving the ultimate goals of higher education [7-8]. The flipped classroom teaching model is shown in Figure 1.

2.2. College Chemistry Teaching

Formulation Path of Chemical Professional Talent Training Plan

Local universities should reflect their positioning as characteristic and prestigious universities in formulating talent cultivation plans clarify the types and objectives of talent cultivation, enrich training specifications, and build a modular curriculum system. The requirements are as follows:

(1) Clarify the type of talent cultivation

(2) Determine training objectives

(3) Refine cultivation specifications

(4) Building a modular classroom system

The establishment of a curriculum system plays a crucial role in the implementation of talent development plans and the achievement of talent development goals [9-10]. Firstly, focus on universality. To cultivate qualified successors, it is necessary to cultivate a group of outstanding talents in ideological and political education. Secondly, highlight the construction of key disciplines. The main courses mainly include two parts: professional knowledge and foreign language skills. Thirdly, it highlights the characteristics of the discipline. The professional direction is divided into several categories: literary translation and foreign language teaching. English majors can be set according to their own training goals and requirements, with the aim of highlighting the characteristics of English majors, diversifying their development, categorizing them, and highlighting their characteristics. Fourthly, make practical teaching a starting point. In the teaching of practice and internship courses, it is necessary to strengthen the teaching of practice and internship courses to enhance students' hands-on abilities [11-12].

Chemistry is a course mainly characterized by experiments, observation, and analysis. Some chemical phenomena and laws are difficult to effectively explain solely. Mechanical explanations can easily make students feel bored, and they can also absorb chemical knowledge and principles blindly. So, in the classroom, teachers can design and explore questions to achieve a student-centered and classroom centered approach, forming a lively classroom atmosphere. For example, when teaching "Nitrogenous Compounds in Production and Life", teachers can design the following exploration activities based on the content of the textbook: (1) What are the laws of ammonia nitrogen decomposition? Whether the decomposition of ammonium salts would produce NH, guide students to discuss the chemical properties of ammonium salts, such as thermal decomposition and reaction with alkali; 2) How can a farmer design experiments to determine the main components of "hydrogen ammonia" in fertilizers when applying "hydrogen ammonia" and urea? This exploratory question, with experiments as the main content, is more likely to stimulate students' desire for exploration. In this process, the teacher can make predictions, methods, processes, and observations of the experiment,

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allowing students to boldly guess that if it is "hydrogen ammonia", they can preliminarily determine whether it is carbonate, sulfite, or ammonium salt of sulfuric acid. After predicting the composition of "hydrogen ammonia", an experimental plan can be developed and conducted, preferably two or more experiments. After exploring the experiment, it can discuss which plan is more reasonable and effective.

2.3. Flipped Classroom

Information transmission and knowledge internalization are two basic concepts in students' learning process. In the traditional teaching model, "information transmission" refers to the mutual influence between teachers and students, as well as between students and students in the classroom, while "knowledge internalization" refers to the completion of homework by students themselves in the classroom, mainly after class, without communication with students, resulting in uneven academic performance. Information transmission "is achieved through pre class videos, learning guides, or online tutoring provided by teachers." Knowledge internalization "refers to the interaction between teachers and students in the classroom, where teachers can answer students' questions, thereby better promoting students' knowledge internalization and improving their learning efficiency. This is the essence of flipped classroom teaching. In other words, flipped classroom teaching is a pre learning teaching method that is autonomous, interactive, and personalized. From this theoretical logic, using flipped classrooms is beneficial for improving the quality of teaching and learning [13-14].

The Application Defects of Flipped Classroom

Students have weak foundation and learning initiative. Due to the relatively weak source of students in local universities, the majority of students have a weak learning foundation and low learning enthusiasm [15]. On the one hand, in the pre class self-learning stage, some students may not be able to complete self-learning tasks as required due to their weak self-awareness, or spend a lot of time on learning due to their poor foundation, but the results are still not satisfactory [16]. From another perspective, students have become accustomed to indoctrination education and passive learning. To enable them to accept new teaching methods in both thinking and ability, and transform them into interactive teaching and positive thinking, this is a major problem in the classroom teaching process. Especially at the beginning of the "flipped classroom", due to the suppressed classroom atmosphere, it is difficult to carry out classroom activities and achieve ideal teaching results [17-18].

Lack of online teaching resources and facilities: High quality online teaching resources and complete teaching equipment are necessary conditions for the successful implementation of "flipped classroom". In flipped classrooms, higher demands are placed on teaching videos, which require shorter and more interesting content. Depending on the videos produced by professional teachers themselves, their role in teaching is limited. In addition, relevant teaching facilities such as online teaching platforms, teaching multimedia, and free wireless networks are also incomplete [19].

The application of flipped classroom in chemical engineering teaching. Flipped classroom, as a new educational concept, is not only a challenge for teachers but also an attempt to apply it to chemistry education [20].

(1) Write guidance cases and related exam questions. In the context of in-depth research on chemistry teaching, teachers can develop a teaching plan or learning task list, and design corresponding chemistry problems for students to learn and think for themselves. At the same time, various communication platforms can be used to have face-to-face communication with teachers and classmates, to solve their own questions and gains, and classmates can also answer each other's questions in the course. Chemistry teachers from various schools should help each other and use collective wisdom to improve teaching materials.

(2) To achieve this goal, provide technical support and build a teaching platform. In the "flipped classroom" teaching mode, chemistry teachers should play both the role of "imparter" and the role of "guide". With the support of online teaching environment, flipped classrooms delegate the dominant power of learning to students, making them the main body of learning and realizing that chemical engineering majors require high practical abilities. At the same time, this also requires teachers to learn to write teaching designs, write and organize classic chemical teaching videos and textbooks, and match them with corresponding text explanations and pictures.

(3) Classroom teaching should focus on "learning" and advocate "teaching" as a supplement.

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In the classroom, the teacher divides students into several groups based on the learning situation of the class. Members of each group communicate with each other, discuss solutions for chemical experiments, check the experimental situation, and if they are unsure, the teacher would provide them with coherent guidance or expand their knowledge based on the students' experience. When some students start working independently or collaborating with others, teachers can provide necessary guidance. They can also refer to detailed answers and prepare or modify them before class.

3. Experiment of Flipped Classroom in College Chemistry Teaching

Research design

1) Research questions

What are students' attitudes towards the flipped classroom model based on microfilms in university chemistry classrooms? What classroom activities do chemistry students enjoy? What is the impact of this model on chemistry students? What suggestions do teachers and students have?

2) Background

This university chemistry course is divided into two semesters and is reduced to two hours per week in the second year. The principles of chemistry are very challenging. Starting from the third semester, a microfilm based teaching model (flipped classroom) has been introduced in chemistry classes to address issues such as limited classroom time, high difficulty in teaching materials, low student interest, and poor self-learning ability.

Data collection and analysis

At the end of the semester, an online survey questionnaire was distributed. The total number of students is 50, and a total of 40 questionnaires were collected. The questionnaire consists of 21 questions, of which the first 19 are multiple-choice questions and the last 2 are open-ended. The first 18 questions use a 7-point scale, where 1=strongly disagree and 7=strongly agree. The 19th question is a semi open multiple-choice question, the 20th question is an open question that extends from the 19th question, and the 21st question is an open question, as shown in Table 1.

Table 1: Setting of Questionnaire Survey.

Projects	Number
Total number of people	50
Questionnaire returned	40
Questionnaire title	21

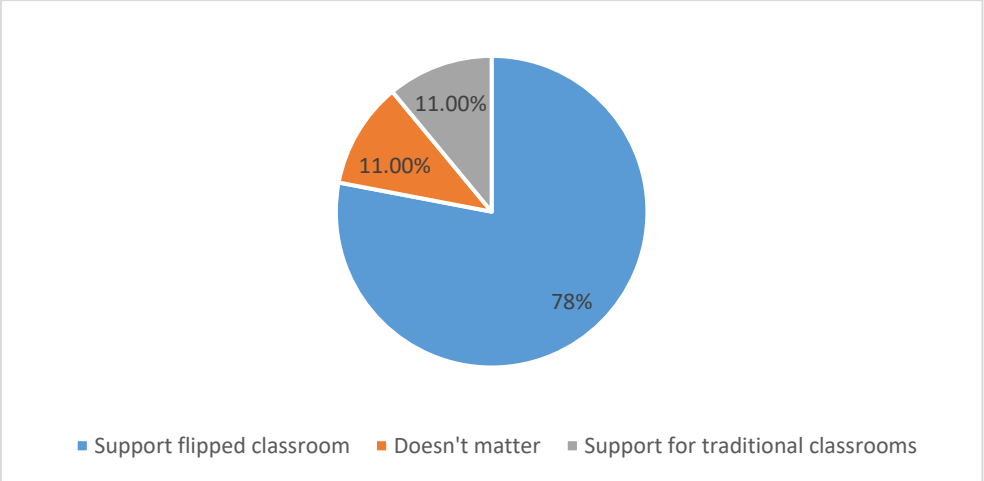

Figure 2: Student satisfaction level

Figure 2 shows that 11% of students do not care about traditional classroom and flipped classroom models; 11% of students are more supportive of traditional classroom models; 78% of students prefer flipped classroom mode.

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Table 2: Reasons and proportion of people who prefer flipped classrooms.

Reason	Percentage (%)
Prefer to watch micro-videos before class	11
Putting chemistry knowledge and chemistry principles in micro-video	5
Accompanying tests with instant results on the web version or watching the micro-video to take notes	7
More confidence in mastering textbook knowledge after flipping the classroom	23
Increased autonomy in learning	23
Can watch them again and again	31

Table 2 shows that 11% of students enjoy watching micro videos before class. 5% of students hope that teachers can add explanations of chemical knowledge and principles in micro videos to increase teacher-student interaction in the classroom. 7% of students believe that the online version of the test, which allows for real-time viewing of results or watching micro videos for taking notes, would improve the effectiveness of the video. The answer to open-ended question 21, "What are your feelings and gains about flipped classrooms?" supports the data in Table 1. Students believe that the form of flipped classroom is very interesting and easy to understand. They gain more independence in learning, improve their ability to learn and memorize words, have more opportunities for communication in the classroom, improve their oral skills, communication and learning abilities. However, it is necessary to improve the content of pre class video testing and clarify its importance in the formative assessment system. The main reason why students appreciate interactive activities in class is that they are interesting. Interesting activities have improved their oral skills and memory abilities. The main reasons why students enjoy watching micro videos are: interest, rewards, relaxed format, detailed explanations, opportunities to take notes, repeated viewing, no interference from other students, access to the internet, and the opportunity to supervise their own learning. This may be related to the form and content of the tests, their interests, and the proportion of the tests in the overall evaluation.

Table 3: Comparison of Scores between Flipped Classroom and Traditional Classroom (Full Score of 100)

	Flipping the Classroom	Traditional Classroom
Average score	89.6	77.1
Highest score	99	95
Lowest score	66	51
Variance	0.1	0.25

The formula for calculating the average and variance of scores is as follows:

$$S^2 = \frac{1}{n}\left[(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + ... + (x_n - \bar{x})^2\right] \quad (1)$$

$$\bar{x} = \frac{x_1 + x_2 + ... + x_n}{n} \quad (2)$$

From Table 3, it can be seen that compared to traditional classrooms, flipped classrooms are helpful in improving chemistry grades. The average score of the flipped classroom model is 89.6, with both the highest and lowest scores higher than traditional classroom scores. According to the variance, the difference in scores among students in flipped classrooms is also smaller.

4. Conclusions

In flipped classrooms, knowledge-based mobile learning is used as a tool and as a goal for students. From the teaching practice of chemistry classrooms, it can be concluded that organizing mobile classrooms in both online and offline forms through the OBE concept can stimulate the development of knowledge-based teaching, effectively improve students' classroom participation and teaching quality, enhance students' enthusiasm and initiative for self-directed learning, and cultivate their group collaboration ability. This can help students develop group work skills. In this way, teachers and students can experience the progress of knowledge education in practice, enrich their teaching concepts, and truly stimulate the reform of teacher education. Regarding other engineering majors with strong

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operability and practicality, if students can use pre class platforms to consolidate their theoretical knowledge foundation in flipped classrooms, the effectiveness of classroom learning would also be greatly improved.

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