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The Expand Application of Micro-lecture in Flipped Classroom in the Reform of Bilingual Teaching of Physical Chemistry Experiment

—Taking Physical Chemistry Experiment Bilingual Course in Zaozhuang University as an Example

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***Abstract*—Under the trend of mixed learning and mobile learning, micro-lecture has become a research focus of educational information resource construction in China. The difficulties in teaching of physical chemistry experiment are the instrument conditions cannot meet the need of each student; the experimental content is cumbersome, teaching methods are outdated. The micro-lecture possesses the characteristics of a short time, small reserves and various forms of expression. Therefore, the introduction of micro-lecture to Physical Chemistry Experiment course helps to enhance the teaching effect. Also, the rational use of image and sound both stimulate students' interest in learning. This paper introduces the background and three-stage development of the micro-lecture, and explores how to combine the micro-lecture with the Physical Chemistry Experiment course to achieve the purpose of improving the teaching effect. The contents of basic chemistry experiments in the universities are diverse, also their teaching environment is open, and their teaching time is fairly plentiful. All these provide a stage for the implementation of flipping class. The application of flipping class teaching is more conducive to cultivating students' innovative ability via the students' maximum 'learning' and the teacher's maximum 'teaching'.**

Keywords—micro-lecture; Physical Chemistry Experiment; flipped classroom; reform

I. BACKGROUND OF MICRO-LECTURE AND ITS THREE-STAGE DEVELOPMENT

The concept of micro-lecture was proposed in 2008 by David Penrose, who is a senior teaching designer and online service manager of the College of San Juan College in New Mexico in the USA. He also advises five steps in building a micro-lecture, *i.e.*, listing the core concepts of teaching; writing a 15-30 seconds of introduction and summary; providing a context for the core concepts; recording videos around 1-3 minutes; designing after-class tasks to guide students in reading or exploring course knowledge; uploading instructional videos and course tasks to course management system. The understanding for people in the concept of micro-lecture experience three-stage development, *i.e.*, micro-resource composition, micro-teaching process and micro-network course. In each stage, the involved focus, form, function and application range are different [1-3].

A. The understanding and practice stage of micro-resource composition

The flaws of the construction model in traditional resource are mainly reflected in the disconnection between construction and application, slow updating, poor interactivity, and low efficiency of application. Under the background of the increasingly diversified and personalized learning styles, both of teaching and learning urgently need short, contextualized, case-based, and easy-to-use types to meet a variety of application needs. The core component of the micro-lecture is the classroom teaching video. It also contains auxiliary teaching resource, such as instructional design, material courseware, practice test, and teaching reflection related to the teaching theme. It is different from the traditional single-resource teaching type. A new type of teaching resource, such as teaching courseware, teaching design, and teaching reflection, are inherited and developed on the basis of the traditional type. This concept focuses on the micro-lecture as a new resource construction method and teaching type; mainly pay attention to the 'basic composition of teaching resource'.

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The advantage of the micro-lecture at this stage is the proposal of a new concept of resource integration or resource construction, that is, using video as the main carrier or presentation method, and integrating the teaching and learning resource related to it. Thus, former independent construction and application in the teaching plans, courseware, lesson, and questions has built a relatively close relationship, which can greatly improve the efficiency of resource utilization. The obvious flaw is that it pays too much attention to resource construction, and turns previous single-constructed resource into a parallel resource construction based on knowledge points or teaching links. Although the central role of teaching videos is highlighted, the source of micro-lecture is mostly from the slicing and processing of traditional video-lesson or in teaching situations from the real classroom or laboratory. Due to a lack of teaching design concept and strategy of micro-lecture in such teaching video, the video is short but without condensed content. These videos are still teacher-centered, but ignore the students' learning activities, also neglect the effective interaction between teachers and students. In fact, the micro-lecture at this stage is more suitable for teachers' observation, reflection, discussion and communication than it for students' independent learning.

B. The understanding and practice stage of micro-teaching process

The year of 2012 is the 'first year' for the construction and development of micro-lecture in China. The micro-lecture with online video as the main expression rapidly spreads across the country in primary schools, secondary schools, universities, and even enterprise education. As a great progress has been made in micro-lecture construction, the application and research of micro-lecture are also urgently needed. The micro-lecture at this stage is not only a new type of teaching resource, but also a short and complete perspective or orientation of a 'teaching process' or 'teaching activity'. The micro-lecture is regarded as a knowledge-based teaching activity and application process. Due to increase in teaching tasks, teaching activities and various forms of interaction, including comment, feedback and other activities, intelligent teaching and learning resource are conducive to effective interaction between teachers and students. Moreover, micro-lecture resource is no longer static, but dynamic developing and further improved. Except for the original micro-video and corresponding micro-teaching, micro-practice, micro-courses, other expanded resource include micro-reflection from teachers themselves, micro-review from the users' comments and comments, micro-feedback from users' feedback and advice after learning also emerge.

At this stage, micro-lecture has been introduced into the 'flipping class' as an important part of the teaching activities, which has become the most important component of the teaching resource. Students don't feel nervous as they are in class when they watch the instructional videos before or after class, or even worry about missing the points. When they have questions, they are easy to communicate with teachers or classmates via the Internet. All these contribute to the students' review and consolidation after class. The development of micro-lecture in concept at this stage highlights the whole process from the composition to the teaching process of the micro-lecture, also the application environment and the component of resource.

C. The understanding and practice stage of micro-network course

Referring from the definition of MOOC (Massive Open Online Course), the micro-lecture can be understood as Mini Open Online Courses, which is a micro-network course. It is intended to combine the national conditions of education in China and fully mobilize the teaching enthusiasm of front-line teachers. The teaching objectives are applicable to the micro-videos in the classroom. Micro-lecture is mainly led by experts and self-developed by teachers, also rooted in the field of real practical activities, which not only benefits teachers' education and professional development, but also benefits teaches themselves. The micro-lecture at this stage is a new kind of micro-network course with micro-video as the main content and presentation method, also can be called as micro-video network course. Its characteristics include prominent theme, clear direction, diverse resource, real situation, short but condensed content, wide application, easy to expand, enhanced interactive and easy to use.

II. PROBLEMS IN THE TEACHING OF PHYSICAL CHEMISTRY EXPERIMENT

Physical Chemistry Experiment is a kind of theoretical, practical and technical course. It integrates basic research techniques and research methods required by various branches in the field of chemistry, and it plays an important role in the practice class of chemical and chemical engineering. There are two notable features in Physical chemistry Experiments:

(1) Physical Chemistry Experiment requires a large number of instruments or equipment set to determine a physicochemical property or study the laws and essential questions in physical chemistry.

(2) Since the physical and chemical properties of the material and the parameters of performance are often measured indirectly, the data from direct measurement need to be mathematically combined and integrated to obtain the desired results.

Therefore, Physical Chemistry Experiment is capable of developing students' comprehensive experimental ability, scientific research ability, data processing and drawing ability.

Some essential problems have been found after teaching physical chemistry experiment for ten years:

(1) Experimental conditions are difficult to meet the needs of the experimental curriculum. Physical Chemistry Experiment is a course that needs to test or verify the physical and chemical properties of substances, so a high demand on the precision of instruments and equipment is required. Although most of the experiments belong to verification experiments, the old-fashioned instruments in teaching are always the uncertain factor in producing disappointing results. In addition, due to the high price of the instrument and limited space, it's hard to assign one instrument to each person, resulting in several

students use one instrument together, which inhibits the enthusiasm of students to participate.

(2) The complex and time-costing process of physical chemistry experiments causes students dependent on text books. Multi-steps in the physical chemistry experiment calls for a sufficient pre-study, or the student cannot grasp the principle of the experiment and the meaning of each step via just learning from the teacher in class. A bad consequence is the students just following the procedures shown in their text book like robots without active thinking.

(3) Traditional teaching methods are backward. Like other experimental teaching, Physical Chemistry Experiment also follows the teaching mode of 'pre-experimental explanation, experimental guidance, post-experiment report, next-experiment comment'. If an abnormal experimental data generated from the student's operation error or equipment failure or other reasons cause, students cannot think out and solve problems through their own analysis, even conceal the teacher's refusal from their worry about gaining a not satisfied score, both greatly weaken the students' enthusiasm.

(4) The procedure of dealing with the experimental data is complicated. To obtain experimental results, several calculation formulas are needed or involving drawing. If there is a mistake in one procedure, the entire experimental value may be far from the theoretical value.

III. THE EXPAND APPLICATION OF MICRO-LECTURE IN FLIPPING CLASS IN THE REFORM OF BILINGUAL TEACHING OF PHYSICAL CHEMISTRY EXPERIMENT

Taking the experiment of 'The Measurement of Combustion Heat' as an example, the application of the flipping class teaching in physical chemistry experiments is elaborated.

A. Before class

Students should download the learning materials published by the teachers for self-learning at least one week before the class. First of all, students understand the basic content of the 'The Measurement of Combustion Heat' through the multimedia courseware. Then, a further understanding of the experimental scene and experimental operation process is gained from watching the videos, especially focusing on understanding and mastering the structure of the oxygen bomb calorimeter, the use of the tableting machine, the three-stage control of the high-pressure cylinder and the inflation method. Students must answer five questions according to what they just learn, the video cannot continue until the correct answers are given. If they fail, they need to re-learn the relevant content. Finally, several simple pre-study questions should be complete, such as what is the system in this experiment? What are the environments? From what ways do the system and environment exchange heat? What issues should be paid attention to when using oxygen? What is the effect of stirring too slowly or too fast? These questions can deepen students' understanding of experimental principles and help to develop the ability of designing experiments independently. During the learning process, students should carefully record the problems encountered and use existing resource to find out answers. For questions that are still unresolved, students can bring them to the class, so the answers can be found out through their discussing with teachers and classmates. In order to encourage students to think, each group of students is required for the preparation of more than one question related to the experiment will be discussed in class.

B. In class

Teachers organize students to conduct experimental operations, which are divided into three stages of pre-experiment preparation, experimental operation, and post-experimental summary. In the experimental preparation stage, the teacher organizes the students to discuss the problems encountered in the study of the 'The Measurement of Combustion Heat'. Once a question is raised, the students fully discuss and answer by themselves. After then, the teacher gives out the answer and makes a summation. In the discussion among students or between teachers and students, students can find out the answer by themselves, even can inspire by the questions raised by other students to deepen their understanding of this experiment. Since then, the teacher emphasizes the precautions in this experiment. Due to the differences in viewing video and actually operating, students are allowed to try important experimental units under the guidance of teachers. In the experiment of 'The Measurement of Combustion Heat', tableting is a part that students feel hard to control well. Teacher organizes students to use the tableting machine for practical exercises in the class. The real operation enables the students to understand controlling the shape of the burning wire to achieve the purpose of uniformly passing the burning filament through the middle of the tablet without being exposed above and below the tablet. This can greatly improve the success possibility in this experiment and enhance students' self-confidence in an independent experiment [4].

In the experimental stage, students directly conduct the experiment according to the design process, observe experimental phenomena, and record experimental data. Adequate preparation can greatly improve the efficiency of students' experiments. At the same time, students are more focused on the operation of the experimental process and the changes in experimental phenomena. The teacher must instruct the students' operation and make a record. When find out an error in students' operation, the teacher is not eager to point it out directly, but to guide them to analyze the problem and find out the answer by themselves. For example, when the temperature-time diagram drawn by the computer does not appear obvious three stages of 'pre-combustion temperature balance, the temperature suddenly rises during combustion, the stable temperature during heat release after combustion', students are accustomed to blaming the problems on instruments and medicines facing to such abnormal results different from the theoretical results. Herein, teachers should guide students to think over the procedures from their own operations and remind the students to judge from the temperature. For example, whether the oxygen is insufficient due to incorrect inflation or oxygen bomb leakage, or the ignition process is improperly operated causing the burning wire to be blown, otherwise the tablet is not activated causing the inflation to disperse the drug, etc. Leading them to find out the possible reasons of insufficient heat release from the

combustion, and finally check each reason may lead to the experimental failure by measuring the pressure or opening the oxygen bomb to see if there is any drug residue, and so on. In observing the performance of students participating in discussions and practical operations in the class, teacher can give out relatively justified points to students. For students who make a sufficient pre-study and better operation, even an active proposal for improvements in this experiment, an encouragement in the score should be considered. Contrarily, for students who are less proactive in learning, teacher should also be patiently guiding them to engage in this experience, lead them feel the joy and sense of accomplishment. After the experiment, teacher should organize a summary of the experiment, and make a comment according to the record of the pre-study review, discussion participation, operation performance and division of labor in each group.

C. After class

Through the QQ group, WeChat and other platforms, teacher and students can continue to exchange and interact with relevant questions about this experiment. The error analysis, experimental reflection and successful experience should be contained in the experiment report; some extra points should be awarded to such active students. Full score in each experiment is based on the students' performance, and are distributed into three parts, including pre-study before class (30%), actual operation in class (40%), and the quality of the experiment report (30%).

IV. SUMMARY

The emergence of micro-lecture conforms to the trend of the times, also follows the development of education. Its prominent advantages are expected to bring unintended effects in the teaching of Physical Chemistry Experiment, which stimulate students' interest in the course and enhance the effectiveness of learning session. However, the emergence of micro-lecture may also bring possible new problems. For example, whether does the fragment learning mode lead to the fragmentation of students' knowledge architecture; whether will the students excessively rely on micro-lecture videos too much making them be lazy in the in-class activities, even destroy their independent learning habit, even enlarge the gap between high-score students and low-score students, and so on. Therefore, it is necessary to strengthen the guidance of students in the teaching thread, including a rational combination the traditional teaching with the micro-lecture. Additionally, we should continuously improve the design of the micro-lecture through the feedback from the students in each session, to make sure each student can make full use of the existing resource and enjoy the active participation in the experiment.

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