

## Research Article

### Research on Teaching Model of Engineering Fluid Mechanics Based on Micro-Lecture

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**Abstract:**To enhance the teaching effect of "Engineering Fluid Mechanics" course in Nanchong Campus of Southwest Petroleum University. This study put forward the teaching method of "Micro-lecture" into classroom on the basis of the study of the existing "Engineering Fluid Mechanics" classroom teaching reform methods. Then the whole process of teaching mode had been built from three aspects: pre-class preparation, classroom learning and after-class expansion. After that, the "Micro-lecture" teaching model in teaching "Engineering Fluid Mechanics" had worked out.

**Keywords:** Engineering fluid mechanics, micro-lecture, Nanchong campus of southwest petroleum university, teaching model

## INTRODUCTION

"Engineering Fluid Dynamics" is one of the most important courses for many engineering majors. The teaching method usually is "Blackboard Writing and Power Point Presentation", leading to the lack of application of modern teaching technology. Therefore, how to stimulate the enthusiasm and creativity of students by changing the traditional teaching mode and how to improve the teaching quality are the problems to be solved urgently in the current teaching process. At present, the reform methods proposed by colleges in our country mainly include:

- Introduction of Computational Fluid Dynamics (CFD) into classroom teaching. Jianget *et al.* (2015) introduced CFD software into Engineering Fluid Mechanics course teaching and making a discussion about docking of teaching and scientific research
- Reform of the fluid mechanics experimental teaching method. Liang *et al.* (2012) analyzed the present fluid mechanics experimental teaching status and the existence of practical problems. Some reforms are carried out in the method of case teaching, based on the teaching orientation, teaching content, teaching mode. Ma *et al.* (2012) explored the mechanics experimental teaching method based on scientific research and carried out the teaching practice application in the

undergraduate's comprehensive experimental teaching process

- Use of multimedia software. In fact, multimedia software is a comprehensive application of the traditional "Blackboard and PowerPoint Presentation" method mentioned earlier in this study and the CFD software-assisted teaching method. It improves teaching efficiency by using powerful simulation function of computer to realize the mode of "Blackboard Writing and PowerPoint Presentation and Software Demonstration".

Song *et al.* (2015) applied the micro-lecture to college physics experiment teaching. Lu *et al.* (2017) applied the micro-lecture to computer experimental teaching. Li *et al.* (2017) applied the micro-lecture to nursing teaching. Wang and Zhang (2017) studied the "flip classroom" based on micro-lecture in college English listening and speaking teaching. Micro-lecture can be widely used in various disciplines of teaching. Ruan (2018) applied micro-lecture to mathematics teaching. Li (2018) put micro-lecture into physical education.

Nanchong Campus of Southwest Petroleum University (hereinafter referred to as Nanchong Campus) has a shortage of teaching staff and problems of insufficient teaching resources. Besides, laboratory construction has just started. Therefore, considering the actual situation, combined Micro-lecture with

traditional class to improve the quality of classroom teaching. This study was conducted in December 2017, China.

### FEATURES AND APPLICATION

"Micro-lecture" is short for "mini-video network course" and is a kind of tiny course relative to regular class, which is used to teach a single point of knowledge or to break a teaching problem. The video length is usually within 15 min. Teachers can require students to watch the micro-lecture video before or through the class. The learning method is very suitable for science and engineering majors which only need to teach a concept, formula, experiment, etc.

**Analysis of Micro-lecture features:** Micro-lecture features distinct, mainly in the following three aspects:

- A single knowledge point to teach. One of the most prominent features of micro-lecture is the fragmentation of knowledge. Different from the traditional class, micro-lecture usually is a short video contains one single point of knowledge.
- Mobile devices can be introduced. Because the main content of the micro-lecture course is interactive activity of using micro-video for network learning, mobile devices such as mobile phones and computers can be fully utilized to make students study at anytime and anywhere.
- Sharing of teaching resources. Since 1993, LeRoy A. McGrew, a professor at the University of Northern Iowa, proposed a 60-sec course to form the prototype of "Micro-lecture". Hu(2011) introduced the concept of "Micro-lecture" to China. During the past 20 years, we have witnessed rapid development of "Micro-lecture".

**Research and application of micro-lecture:** After years of development, the application of Micro-lecture research has also been extended to all aspects. On the basis of analyzing the characteristics of human brain information processing, Zheng (2014) established a three-layer design model, consisting of instinct layer, behavioral layer and reflective layer. According to the model, the paper explained strategies of realizing

instinctive layer design, behavioral layer design and reflection layer design during Micro-lecture teaching.

### CASE ANALYSIS

Based on the analysis above, a three-layer model consisting of instinct layer, behavior layer and reflection layer is designed to introduce "Micro-lecture" teaching into the teaching of "Engineering Fluid Mechanics".

**Micro-lecture teaching design:** Micro-lecture design process is shown in Fig. 1.

"Micro-lecture" should be based on the learner in its design process, emphasizing the acceptance of the learners. The key point is the topic selection, course design and video selection.

**Selection of "micro-lecture" topics:** For the "Engineering Fluid Mechanics" curriculum, micro-lecture topics are mainly from the formula derivation and experimental introduction. For example, Derivation of Navier-Stokes Formula was chosen as the micro-lecture topic, leading to an enhancement of teaching effectiveness.

**Course design:** Although the micro-lecture is no more than 15 min of teaching time, micro-lecture should include a complete set of micro-teaching programs, namely, "micro target", "micro teaching plan", "micro handout", "micro exercise". The difference between the traditional teaching program and the micro-lecture program lies in the meaning of "micro", which means small and single.

The traditional teaching program usually has multiple teaching objectives in one lesson, while the "micro target" mainly aims at the realization of a single teaching goal. The "micro teaching plan" and "micro handout" refer to the teaching plan and the handout are shorter compared with the traditional ones. "Micro exercise" is used to consolidate the basic knowledge and can inspire students to think.

**Video selection:** There are many ways to make micro-lecture videos. According to the "National Micro-lecture Teaching Contest for Universities" organized

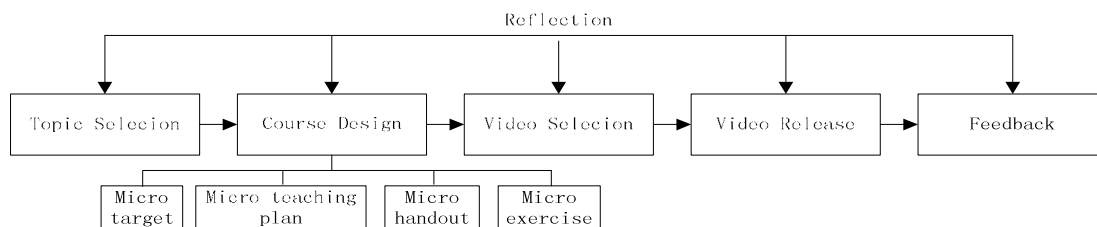


Fig. 1: "Micro-lecture" design process

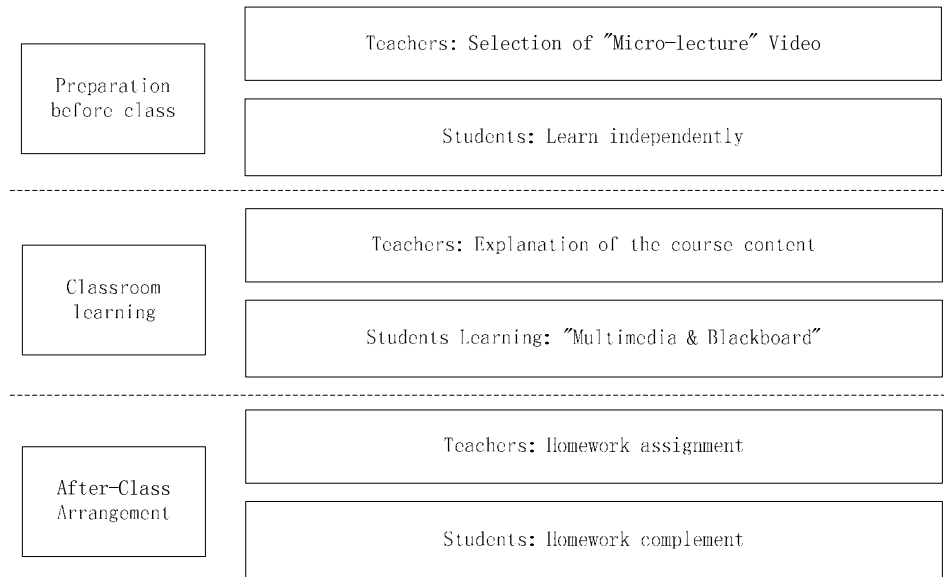


Fig. 2: The whole process of teaching mode

by the Ministry of Education's National Network of Teacher Training Centers and the micro-lecture competition conducted by the Education Management Information Center of the Ministry of Education, micro-lectures are usually recorded with video cameras, iPads, recording software, recording studio and so on.

**Establishment of the whole process of teaching mode:** Based on knowledge of the course, teachers stratified and fragmented the knowledge points, making the formation of both independent and relevant knowledge points to form the construction of curriculum knowledge map. For each fragmented knowledge point, teachers can develop micro-lectures. The construction of the teaching model is shown in Fig. 2.

**Preparation before class:** After studying "Engineering Fluid Mechanics" textbook, we can find out that the independent knowledge points in each chapter are "formula derivation (or experiment introduction) and formula application". Based on the past teaching experience, the formula derivation parts are complicated and boring and students' interest in learning is not high. At this point, we can learn from the "micro-lecture tutorial" mode that through lively and interesting micro-video, the use of teaching video triggering students' thinking and discussion. For example, during teaching process of "basic fluid-viscous fluids", a small experiment was introduced: if we pour a glass of water or pour a glass of oil, which one could be poured more easily?

Besides, how to design "micro task" reasonable is also to need to think carefully by teachers. Micro-tasks should be investigated based on the concept of discrimination. For example, under what circumstances,

water is considered as a compressible fluid? Under what conditions is the air considered incompressible?

**Classroom learning:** Although we should focus on the classroom teaching, "micro-lecture" should be placed outside of class rather than inside the class. In the classroom, teachers can correct the mistakes made by students because they have completed their micro-tasks before class. Based on previous teaching experience, we know that students often make mistakes on the basic concepts, such as "compressible fluids" and "incompressible fluids". At this point, teachers can distinguish the concepts in the classroom rather than teach the concepts.

When basic knowledge points are taught in front of class, we can focus on the parts which requiring continuous explanation by teachers in classroom learning, such as formula application and so on. In addition to the traditional teaching methods of "Blackboard & PowerPoint Presentation", teachers can introduce CFD method and use digital model to enable students to understand knowledge point more intuitively. For example, in explaining the application of the fluid dynamics Bernoulli equation, students are required to learn differential pressure flowmeter measurement principles. For example, we can use CFD software to establish a standard orifice flowmeter model and draw the pressure drop maps and velocity maps. This method allows students to understand the Bernoulli equation easily. However, the application of CFD software is complicated and cumbersome, it is not appropriate to pay attention to the modeling process in the classroom.

**After-class arrangement:** In addition to finishing homework assignments, students can also watch extended videos via a web-based platform. This types

of videos can be selected about how to create CFD software, or how to set boundary conditions, initial conditions. We also can choose videos such as large fluid mechanics experiments.

### CONCLUSION

The teaching mode of "Micro-lecture" has a great impact on the traditional teaching mode. In this disruptive teaching reform, teachers must avoid falling behind. We are faced with many difficulties and need to do some research and exploration. Admittedly, micro-lecture will not replace the traditional teaching methods, but can promote the majority of university teachers to think about the traditional teaching methods.

"Micro-lecture" teaching method in *Nanchong* Campus fits in with the requirement of the university and is strongly feasible. Not long after the undergraduate admissions work was done in *Nanchong* Campus of Southwest Petroleum University, the teaching mode of "Micro-lecture" is still in the stage of theoretical research. In view of the problem of how to make micro-lecture video, how to arrange the micro-tasks and how to improve the assessment method reasonably on the basis of micro-teaching is the direction of further research.

### ACKNOWLEDGMENT

This research was financially supported by the Teaching research project of *Nanchong* Campus of Southwest Petroleum University under grant number 2017-KC-NC02.

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