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RESEARCH ARTICLE

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## RESEARCH ON TEACHING MODE OF *ENGINEERING MATERIALS* FOR UNDERGRADUATE MAJOR OF NONDESTRUCTIVE TESTING

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### ABSTRACT

The advantages and disadvantages of several popular teaching modes are analyzed, and puts forward and designs interactive teaching modes for *Engineering Material* courses. A total of 108 students from 4 classes were selected as experiencers of the teaching mode. Specific teaching contents are selected for teaching practice according to various teaching modes. Questionnaire survey was designed after class. The questions mainly related to the teaching effect and students' satisfaction with the course, and the survey results were processed and analyzed. The results show that up to 57.4% of students are more satisfied with the interactive teaching mode, which proves that the designed interactive teaching mode is a popular teaching method with good teaching effect.

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### INTRODUCTION

The traditional teaching mode has been used since ancient times. The classroom adopts the mode of teacher teaching and student listening, which is characterized by very detailed teaching contents and successful "output". However, with the changes of the times, students in the era of knowledge explosion have been able to independently acquire a lot of knowledge outside the classroom. The contents of teachers are known or have been deeply understood by students, and the "receive" process of students is of little significance, which directly leads to a great discount of classroom efficiency. In the traditional teaching mode, there is little communication between teachers and students, so that the information "output" of teachers and "receive" of students are not equal. In order to improve the efficiency of teaching, scholars in the field of education continue to innovate and summarize the effective and popular teaching methods. In the "Education Dictionary", these educational methods are defined as "teaching mode". At present, in the field of education, the following four teaching

modes are the most widely practiced: Problem-Based-Learning (PBL), Presentation- Assimilation- Discussion (PAD), Flipped classroom teaching mode, 5 Star Instructional Design Rating (Feng, 2016 and Sun, 2017).

**Several new teaching models that are currently of general concern to the education community**  
**PBL teaching mode:** PBL teaching model was first proposed by American medical experts (Dunsmuir, 2014). One of the biggest differences between PBL and traditional teaching is that learning begins with a problem that needs to be solved, and there is no fixed solution or procedure for the problem. In the process of solving problems, teachers and students freely combine and cooperate with each other. The classroom emphasizes the position of students as the main body and teachers as the guide. In the teaching process, teachers pay attention to encourage students to innovate and find their own ways to solve problems. Specifically, the process of PBL teaching mode is that teachers select relevant contents according to the applicability of teaching contents, propose and set corresponding problems. Students are problem-oriented and work in groups to collect data and analyze problems. Students show the whole learning process and the

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solution of problems in the form of PPT explanation. Finally, teachers summarize and evaluate students' performance.

**PAD teaching mode:** Professor Xue-xin ZHANG from the Department of Psychology of Fudan University summarized and innovated the teaching model of the divided classroom teaching (Zhang, 2014). The teaching model mainly includes three links: presentation, assimilation, discussion. In the three links, the presentation process from the traditional teaching methods of every little thing to be clear to the highlight of the part; the process of assimilation from teachers' task to students', that is to say, the students marked the homework by themselves rather than by the teacher; the process of discussion is conducive to strengthening students' ability in cooperation and communication. In the whole teaching mode, compared with the traditional classroom, teachers take up less classroom time and students have more opportunities to play. However, no practical results have been seen in the cultivation of students' problem-solving ability under the model of divided classroom teaching.

**Flipped classroom teaching mode:** The characteristics of flipped classroom teaching model are: students put forward questions in class, teachers explain the questions according to the questions raised by the students, the discussions and interactions between teachers and students are the main content of the class. Recording knowledge points into videos on the Internet replaced the process of teaching knowledge points in class by the teachers. And it is convenient for students to study by themselves after class (Jing, 2017). In fact, solving the questions randomly raised by students in class puts forward higher requirements for teachers' teaching skills. The way of asking questions also enables students to learn to think independently and explore their own knowledge loopholes in the learning process. After class, students can watch video again and again without constraint, which has played an important role in the teaching of information technology (Dong, 2015). However, there are still some aspects to be improved in the flipped classroom teaching mode, such as: video watching for too long will affect students' eyesight; when students use the Internet to watch video, they cannot resist the temptation of websites unrelated to learning, which affects the teaching effect; students put forward different questions, teachers in the choice of issues can not consider all students and so on.

**5 Star Instructional Design Rating:** The principle of 5 Star Instructional Design Rating is basically the embodiment of the "central" thinking. In this teaching mode, focusing on the focus instead of the traditional focus on information presentation enables learners to get involved in real life problems and integrate knowledge into real life to promote learning (Wang, 2015). The main points of the 5 Star Instructional Design Rating: (1) Let students into solving practical problems; (2) Activate the necessary basic knowledge of the students; (3) Learn new knowledge; (4) Solve problems with new knowledge of learning; (5) Integrate new knowledge with existing knowledge in their own way, through a comprehensive study. It can be understood that the 5 Star Instructional Design Rating is very helpful to cultivate students' knowledge points, but it is also lack of training on students' skills.

**Interactive teaching method:** the "Interactive teaching method" is a teaching method discussed in this course. The mode and structure of "interactive teaching method" need to be

designed and analyzed in detail. Different teaching contents are selected and different teaching modes are adopted to give lectures to students. At last, students are invited to evaluate the effects of various teaching modes and evaluate the most suitable teaching methods for *Engineering Materials* course.

### **Design of interactive teaching mode of *Engineering Materials***

**Course overview of *Engineering Materials*:** "Non-destructive testing technology" (NDT) refers to the method and technology for testing structural damage, service life and internal defects of components without damaging or affecting the structure and service functions of the objects being tested. The core courses of the major of "Non-destructive testing" include five conventional testing methods: electromagnetic testing, ultrasonic testing, and ray testing, etc (Ren, 1989). *Engineering Materials* is a core course of measurement and control technology and instrument nondestructive testing. Through in-depth study of this course, students can have a comprehensive understanding of the structure, performance and processing technology of metal, inorganic nonmetal and other materials. This course starts from the introduction of material forming technology and guides students to understand the application of engineering materials in mechanical engineering. Through the study of this course, students can have a deep understanding of the use performance and process performance of engineering materials, laying a good theoretical foundation for mastering the use conditions of mechanical parts in practice. At the same time, this course also gives a detailed introduction to several common materials in mechanical engineering, and explains in detail the processing technology of several engineering materials, such as thermal processing, casting, pressure processing and welding. The macroscopic law and microcosmic mechanism combine, give priority to expounding macroscopic law. In short, "engineering materials and mechanical properties" is a basic course of measurement and control technology and instrument nondestructive testing major. It plays an important role in training students' basic knowledge of engineering materials, engineering practice ability and ability to solve practical engineering problems. Due to the heavy learning tasks of professional core courses, direction core courses, basic platform courses, general education compulsory courses and other courses, as well as students' general aversion to learning, *Engineering Materials* is often marginalized in the minds of students. More and more attention has been paid to the research of improving teaching effect and teaching method, and the exploration of improving the learning efficiency of *Engineering Materials* for students majoring in nondestructive testing. The application and selection of teaching mode should be compatible with the specific educational disciplines and teaching content. According to the characteristics of *Engineering Materials*, the teaching mode suitable for the characteristics of *Engineering Materials* is designed according to the characteristics of *Engineering Materials*, such as more knowledge, more concepts, scattered knowledge and loose connections between knowledge points.

### **Design of interactive teaching mode in *Engineering Materials***

**Design of teaching mode:** According to the characteristics and knowledge structure of the course, the teaching mode of *Engineering Materials* in NDT is discussed.

**Table 1. Students' questionnaire survey and analysis of teaching effects of different modes**

The class	A. traditional teaching methods	B. Interactive teaching method	C. Problem-Based-Learning (PBL)	D. Presentation-Assimilation-Discussion (PAD)	E. Flipped classroom teaching mode	F. 5 Star Instructional Design Rating
170811	9/26	11/26	3/26	1/26	1/26	1/26
170812	6 /27	17/27	2/27	1/27	1/27	0/27
170813	1/25	14 /25	3/25	2/25	2/25	3/25
170814	1/30	20 /30	3/30	2/30	1/30	3/30
Total of 4 classes	17/108	62/108	11/108	6/108	5/108	7/108
The ratio	15.7%	57.4%	10.2%	5.6%	4.6%	6.5%

The whole teaching process consists of the following parts.1) Make class notes to be homework. For some students notes do not know what is the key, often affecting the lectures; do not take notes and often think of distraction, sleepiness and other phenomena, designed the class notes. Divide the key content of this class into several small knowledge points, each small knowledge point as a small problem. Class notes take the form of a number of small questions to fill in the blanks, the number of words needed to do not affect the class, and the notes are often taken continuously. Class notes are used as class assignments to be handed in before the end of the class has played a role in urging students.2) The guiding ideology emphasizes that students learn in class, do not take tasks outside of the classroom, and grasp the efficiency of classroom learning. Because of the heavy learning tasks of compulsory courses such as core courses, basic platform courses and general education courses in other directions, students can strive for more time for students to learn their favorite knowledge and technology and develop their own strengths.3) Supervise students' daily study and review in the form of classroom quizzes. According to the content of the chapters, 2-3 quizzes will be organized in class, and each quiz will last for 20-30 minutes. After the course is finished, the teaching task will be almost completed.4) Pay attention to interactive sessions such as class discussion and classroom questions to cultivate students' interest and initiative. PPT is used to show questions in the form of multiple choice questions, judgment questions, and questions and answers, etc. Interact with the students by raising your hands and adding points, the interactive time is 5-10 minutes in each class, and the questions discussed are both the content of the lecture and the contents of the past.

#### **Design of the assessment mode of *Engineering Materials*:**

According to the teaching content of each link, there are separate records, which can be used for the assessment of students at the end of the period. 1) Record of class work. The number of class absences can be seen from the submission of class work. The main difference is that some students are more serious, writing is very neat, some of the words are scrawled. Class work can be part of the usual grades, but there is little difference between students.2) Usually quiz records. Because of the implementation of the method of multiple classroom quizzes, the average scores of multiple quizzes can be taken as the mid-term scores of the final assessment. Through the analysis of quiz results, we can find that some students' quiz results are very unstable, which is conducive to timely grasp of students' learning status, timely guidance to students, to help students solve problems.3) Record of class discussion. Through class discussion, the distribution of students' academic achievements can be clearly seen. The students who actively spoke and participated in the question discussion, and the accuracy rate was very high, most of these students were excellent students.

The class discussion grade is also part of the assessment of the usual grades.4) The comprehensive assessment results at the end of the semester include the results of homework in class, average results of mid-term quiz, results of participation in class and results of final exam. Due to the relatively small proportion of the final exam scores, students are familiar with the course, which greatly reduces the pressure of the final exam.

**Analysis of teaching effect of teaching mode:** The objects of this teaching reform experiment are 2017 students of college of test and optoelectronic engineering, Nanchang hangkong university, with a total of 108 students in class 1-4. After the completion of the course teaching, the results of the classroom teaching reform using the interactive teaching method were evaluated by designing a questionnaire and combining the results of the examination. The specific contents of the questionnaire are designed as follows: The course *Engineering Materials*, according to our actual situation, is suitable to adopt the following teaching method, please choose (). A. traditional teaching methods; B. Interactive teaching method (currently adopted teaching method); C. Problem-Based-Learning (PBL); D. Presentation-Assimilation-Discussion (PAD); E. Flipped classroom teaching mode; F. 5 Star Instructional Design Rating. The survey results are shown in Table 1. It can be seen from Table 1 that, taking the class as the unit, among the five teaching modes in the survey, the number of people who choose "interactive teaching method" exceeds those who choose the other five teaching modes. In terms of the overall percentage, 57.4% of the students chose the interactive teaching method, which is far beyond the other five teaching modes. The survey results can indirectly indicate that the teaching effect of "interactive teaching method" is better than the five common teaching modes in the class of *Engineering Materials*.

#### **Conclusion**

By practicing the new teaching mode, the classroom atmosphere can be effectively improved during the teaching process, and the initiative of students' learning is obviously improved. The teaching effect is better than the other five teaching modes in the interactive teaching method. Since this course only involves *Engineering Materials*, whether it is suitable for teaching other subjects remains to be further practiced.

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