Exploration on Instructing Mode of the Curriculum - *Fundamentals of Materials Science*

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Abstract—In the practice teaching of 'Fundamentals of Materials Science' course, we adopt new modes and methods to enhance classroom interaction, arousing the enthusiasm of teachers and students to interact, and making classroom teaching more efficient. This new teaching mode mainly consists of VR teaching, Moocs and project discussion education methods, which can help students effectively master course content in a good interactive environment and improve the overall quality of education.

Keywords—Guidence mode; VR teaching; Moocs; Project discussion education mode.

I. INTRODUCTION

'Fundamentals of Materials Science' course is a professional basic course for mechanical and material majors, and its importance is self-evident. This course aims to make college students to learn the basic concepts of materials science, so that college students can have a preliminary understanding of materials structure, processing methods, mechanical properties and materials detection and analysis methods, master relevant analysis software and mechanical engineering software, and learn the basic methods of selecting and using materials under different working conditions. In addition, after learning and mastering the basic ideas, basic theories and professional skills of material selection of various metal and non-metal engineering materials through this course, college students should also have the preliminary potential to select metal and non-metal materials according to different needs and develop processing technology and strategy system of the computing device parts. At the same time, the vast majority of mechanical graduates will choose to be engaged in mechanical product design and manufacturing related work, and in this work process, the selection of materials for various components and parts and other desktop components, is one of the important links to determine product performance and user experience. Especially in today's highly developed productivity, a variety of new polymer materials and 3D printing and other new materials processing and manufacturing processes have appeared in a blowout. Research on new materials is an important way to improve product competitiveness, control costs, enhance user experience and product innovation in industrial production. Therefore, 'Fundamentals of Materials Science' plays a pivotal role in the training plan of mechanical major college students, and the teaching methods and teaching objectives of this course have attracted much attention.

In the teaching planning of the major, 'Fundamentals of Materials Science' is planned to have 32 class hours, including 26 theoretical teaching hours in the traditional classroom, and 6 experimental courses to train the practical ability and theoretical combination ability of college students. The teaching content mainly includes: the classification of materials, the basic properties of materials, the performance analysis and testing methods of materials and corresponding software, as well as the selection method and preparation process of different materials (metal materials, polymer materials, ceramic materials, composite materials). The experimental teaching content mainly includes: preparation of metallographic samples, testing of mechanical properties such as hardness of samples, observation and judgment of all phases in Fe-C binary alloy phase diagram, etc. The theoretical teaching and experimental teaching content of this course are combined and correlated with each other, and the content is highly covered. However, due to the limitation of the length of class hours, the number of experiments and experimental equipment, the theoretical teaching is not deep enough, and the practical content is not perfect. In view of this problem, we should reform the teaching mode and put forward effective measures to ensure the teaching quality. As shown in the Fig.1, this paper adopts three reform methods, and the three measures are interrelated.

II. REFORMATION ON PRE-CLASS PREPARATION

With the industrial transformation of information technology and the innovation of various mobile office equipment, network teaching is becoming more and more important[1]. Meanwhile, Moocs and other network teaching platforms emerge at the right moment.

Different from the traditional teaching mode, APP teaching mode such as Moocs has its unique advantages [2,3]. Mooc network learning interactive software developed based on information platform supports large-scale online learning, breaks the spatial limitations of traditional classroom teaching, and greatly improves the dissemination and sharing of knowledge. Through Moocs, teachers can better prepare for lessons, while students can also make better preparation before class.

Interest and hobbies are important factors to stimulate the enthusiasm of college students in class. The traditional classroom teaching mode has been difficult to mobilize the enthusiasm of college students in class, resulting in a serious decline in learning efficiency.
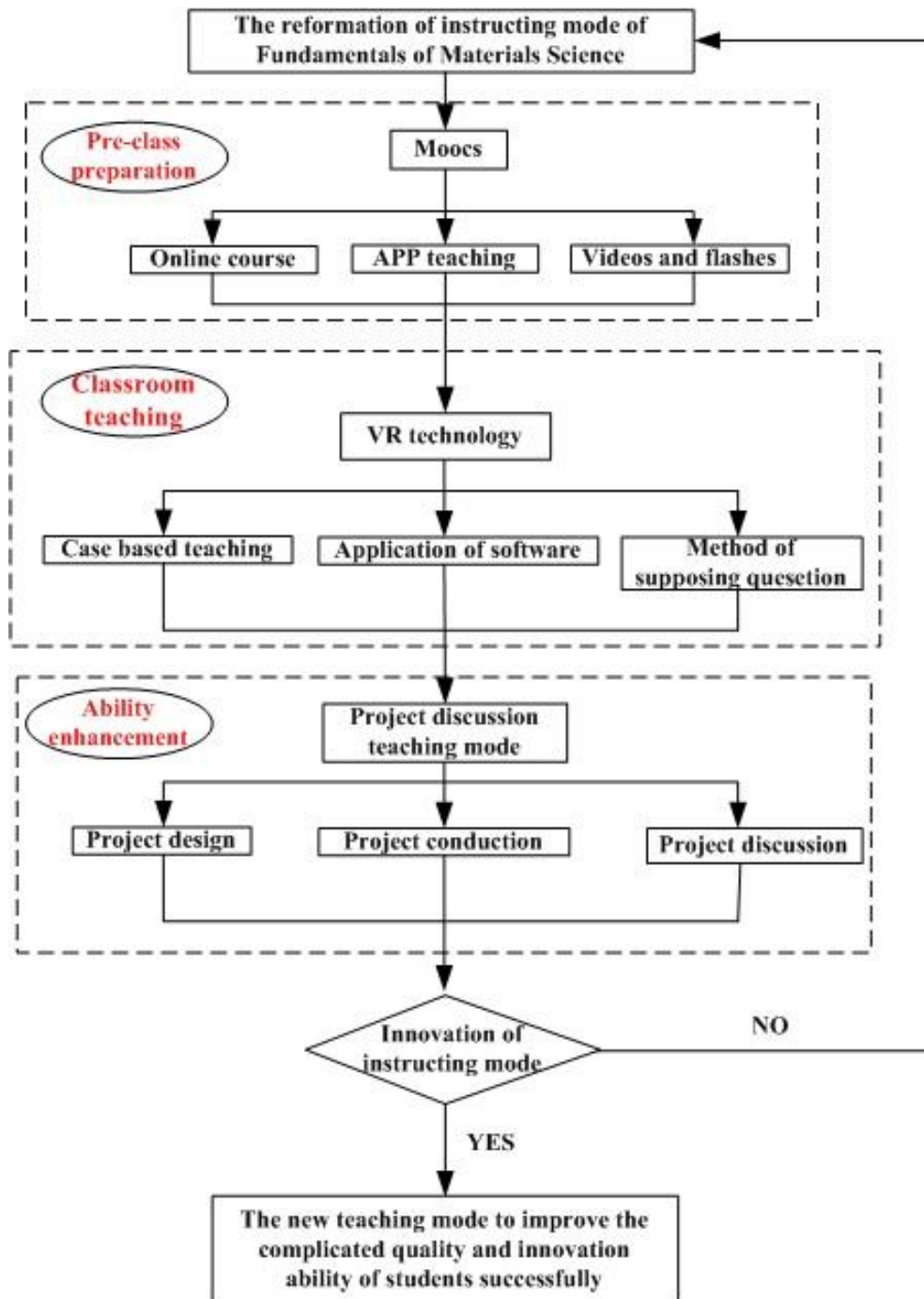

Fig. 1. *Schematic design of instructing mode of fundamentals of Materials Sciences*

The course knowledge of "Fundamentals of Materials Science" is difficult to understand, and the text is rigid and boring. If college students cannot be successfully motivated to learn, the teaching effect will undoubtedly be inefficient and they cannot keep up with the course progress only by rote memorization. Due to the continuous development of information industry, college students acquire knowledge in more and more diversified ways, teaching mode should also be more diversified. The multimedia features of the network teaching platform can greatly enrich the learning resources of the course, so that college students can feel and learn from many aspects. Under the guidance of online courses, college students can have rich imagination of new courses, improve their subjective initiative in course learning, and get twice the result with half the effort[4]. When college students have a certain understanding of the courses they have learned, they can understand teachers' ideas more effectively in classroom learning. Classroom efficiency

and interaction between teachers and college students are further improved, forming a virtuous circle. Through the multimedia resources in MOOC, the processing process of engineering equipment can be vividly demonstrated, and the processing and manufacturing process of experimental equipment not available in schools and advanced manufacturing technology in industrial production can be displayed to improve the classroom teaching content [5].

III. REFORMATION ON CLASSROOM TEACHING

In the typical educating in study room it is located that the educating outcomes are no longer satisfied. Only about 30% of college students can do enough preparation and master all the key points of knowledge, 50% of the college students solely grasp section of the information factors in the lecture room teaching, and 20% of the college students can't be aware of and grasp the know-how factors due to the terrible studying potential and understanding machine in their minds. Therefore, it is critical to promote the gaining knowledge of effectivity in the school room and it is critical to reform the educating mode in the classroom.

In addition to the network teaching platform, the development of AR, VR and other technologies also provide new ideas for classroom teaching [6]. VR technology is one of the most effective strategies to optimize the quality of teaching and improve the enthusiasm of college students. VR technology combines 3D modeling technology, 3D visualization technology and digital technology, which can simulate the process of product manufacturing and assembly, provide correct guidance for industrial production and determine the feasibility of product processing and assembly. The introduction of VR technology in the teaching process enhances the interaction of the classroom, enables college students to have a more intuitive feeling about engineering software and equipment composition, greatly stimulates their thirst for knowledge, and thus improves the efficiency and quality of classroom teaching. DEFORM software was used to assist teaching in the teaching process of 'Fundamentals of Materials Science'. DEFORM is a simulation software based on finite element analysis method, which can simulate the feasibility of metal material forming method and various processing technology. Before the manufacture of new products, the software can simulate and analyze the whole process, and optimize the design for the key parameters in the process, so as to enhance the feasibility of the process, refine the process flow, and control the cost. In classroom teaching, the software can be used to show the practicability of engineering materials and processing technology to college students more directly. For example, in 'Fundamentals of Materials Science' of teaching, the teachers can by DEFORM software to simulate material heat treatment process, through the research on the simulation results, in combination with cloud animation, can be more intuitive to show simple concepts of heat treatment process, to better make students have

interest in learning, promote students' active learning of the classroom knowledge. At the same time, AR technology plays a very competitive role in some complex engineering scientific research problems, which helps to improve the creativity and innovation potential of college students [7].

IV. REFORMATION ON ABILITY ENHANCEMENT

After The task-guided education mode optimizes the classroom interaction environment, improves the participation of college students in learning, and can better exercise students' professional ability. The task-guided education mode takes students as the main body, takes groups as the unit, and deals with practical problems in engineering practice under the guidance of teachers [8]. The task-guided education mode can be divided into four stages: imitation, application, optimization and innovation, among which the last three stages are the emphasis of this model. To be specific, teachers need to provide practical cases in the process of engineering practice, while college students need to find problems and put forward basic ideas to solve problems, and design effective solutions based on their own knowledge [9]. In the process of implementation of the program, the communication and debate among college students and brainstorming play a positive role in promoting the solution of the problem, and in the process of improving the communication and practice ability of college students, gain practical experience.

In the teaching of 'Fundamentals of Materials Science', the project discussion teaching module is set up to enhance the comprehensive ability of college students to deal with complex engineering problems and the innovation ability to solve engineering problems. Take the example of determining the choice of metal material for a particular component in a device. College students are divided into five groups, each consisting of 5-6 college students, responsible for a specific equipment component, such as bearings, gears and connecting rods. Team members work together to determine the process flow, complete the components of the machining and manufacturing process design. At the same time, they need to put all the work procedures and work records on PPT. One representative of each group can make a presentation, and other group members and the advisor can raise questions and suggestions to the representative of the group. Through this teaching mode of project discussion, it can better promote the exchange and sharing of ideas among college students, and improve their ability to innovate and solve practical engineering problems while mastering professional knowledge.

V. SUMMARY

Through the attempt of new teaching mode, the teaching quality of 'Fundamentals of Materials Science' course has been greatly improved. Through the application of MOOC, VR technology and project discussion teaching mode, college students' thirst for knowledge and learning enthusiasm are greatly

improved, the classroom environment is more active, their thinking is broader, and their learning ability and innovation ability are also effectively exercised.

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