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Teaching Reform of Mechanics of Materials on Educating Students

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Abstract: In order to meet the request of the development science and economy of national, students possess knowledge and virtue are needed eagerly. Thus, teaching reform of mechanics of materials that course content arrangement and instructional design is corresponding to cultivating students is necessary. To realize this purpose, we explore the methods varies with improving the effect of learning together with bring up virtues of teaching of mechanics of materials. The reform including teaching method, engineering case and examinations are implemented. The reformed teaching method is not a teacher main show, it incline to cultivate the students' ability to learn independently. Selecting engineering cases that meet the relative knowledge points to educate science and engineering students. The mode of examinations and interaction between teacher and students are also improved to practice training talent.

Keywords: Teaching Reform; Mechanics of Materials; Cultivating Students

Mechanics of materials which connected closely with engineering practice, is an important course of science and engineering in colleges and university. Mechanics of materials makes the role of bridge of theoretical mechanics learned earlier and structural mechanics learned later. Analysis methods of mechanics of materials could be used in solving engineering problem existing industry and civil engineering. And mechanics of materials is also the foundation of machinery design, structure design, reinforced concrete, steel structure, etc. Therefore, comprehending knowledge well of mechanics of materials can both bring up the ability of theory analysis and engineering practice of the students.

1. Reform of content and teaching methods

Mechanics of materials belongs to solid mechanics, is the science of investigating the deformation of engineering components. The main task of mechanics of materials is studying problems of the strength, stiffness and stability of components under external force[1]. There are requirements for strength, rigidity and stability as machinery in machinery, structures in buildings and daily necessities, so the knowledge of mechanics of materials is widely used in engineering. For the purpose of cultivating students with ability and virtues, course content and instructional design is modified more rationally. The outline of teaching reform is illustrated in Figure 1.

1.1 Course content

Outstanding mechanics are introduced in preface explanation to know the history of the development of mechanics. To arouse the enthusiasm of the students to love mechanics, the prominent achievements of foreign and domestic scientists

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as Galileo, Newton, Einstein, Euler and Qian Xuesen, Qian Sanqiang, Zhou Peiyuan, Qian Weichang etc., is explained to students to convey the scientific spirit of advocating science, pursuing truth, seeking truth from facts, willing to contribute and patriotism.

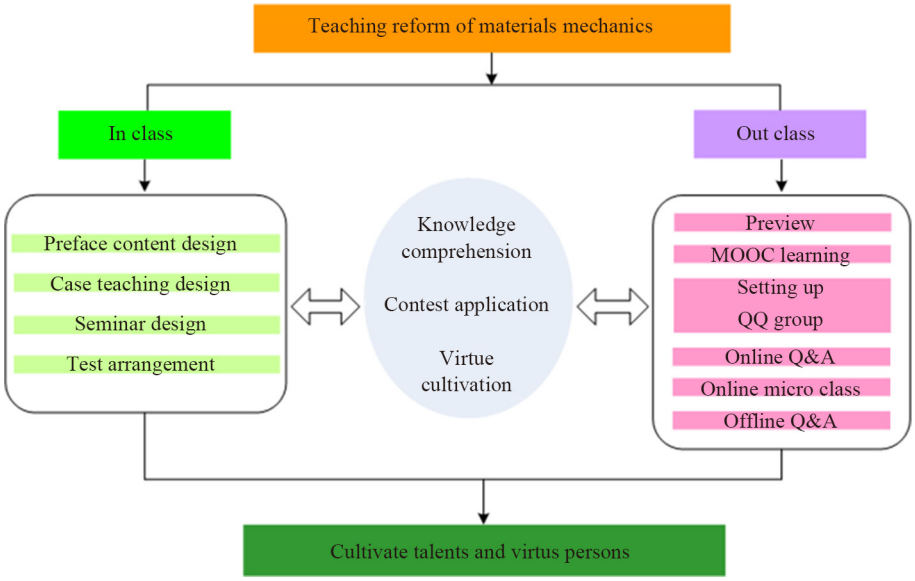

Figure.1 Outline of teaching reform of mechanics of materials.

With the development of science and technology, great changes have taken place in the idea of design, analysis and the methods of manufacture of engineering, so the needs of engineers for basic knowledge are also changing. Hence, the inheritance and update of the basic knowledge of mechanics of materials is reconsidered. Based on keeping the main content of mechanics of materials, we introduce the fiber reinforced composite material, smart materials, MEMS and simplify the knowledge that is not closely related to engineering practice.

1.2 Teaching methods

The traditional teaching methods is the teacher tells the content of the course on the podium, and the students listen to it on the seats in the classroom. The improved teaching method is combine online and offline teaching. Since the course hours limit now, if the main content of the course needs all explained in the class, there will be a lot of knowledge to be taught in every class hour, the class time will be very tight, and it will be affected the understanding ability of students. So part of the knowledge is chosen for students to learn by themselves in the MOOC, and then the teacher will deal with difficulties and doubts in the class according to the students' feedback on the online knowledge. Mechanics of materials MOOC of Harbin Institute of Technology is a online open national excellent course. We possess the excellent online resource. Besides our institute there are also online open courses of other institutions of higher learning, which is mechanics of materials MOOC is a online open national excellent course, can be used for students to choose online learning.

The learners of mechanics of materials are second-year or third-year college students majoring in electro mechanics, aerospace, mechanics, civil engineering, transportation, materials, environment, energy etc. They almost have no idea about engineering background and practice, let alone engineering experience[2]. Since the knowledge of mechanics of materials is abstract and difficult to understand, if the teacher completely follows the text without considering related to the major in the class, it will cause the students feel boring. So case teaching with corresponding to the knowledge point of the course is implemented for excited the interesting and improved the efficient of the study of students. The pictures and short movies are shown used for explanation and analysis corresponding to the related knowledge point. Like shafts and gears transmission mechanism in machinery, the teacher analyze the force of shafts and gears to let the student to know the principle of the mechanism movement. The connection of steel plates and screws is displayed for analyzing the extrusion and shear forces of screws and also the tensile force of steel plates. Zhouzhou Bridge built by Li Chun in the Sui Dynasty is used for analyzing of materials and structure[3]. For torsion deformations, drive shaft in an automobile, stepped shaft in machinery, the famous Tacoma Suspensions Bridge accident in the US, is presented in the class[4]. The cases of bicycle, Quebec Bridge in Canada[5],

forced environment of bridge piers and aircraft etc. are emerged in classroom teaching. During the teaching process, we have been constantly updating engineering cases related to course content for cultivating the ability of learning and engineering thinking of the students.

For training the ability of learning independently and understanding of knowledge to the students, seminar of the course is designed. About 50 students is divided into 7 groups, each group have 7 or 8 persons. Mechanics contest questions, actual engineering problem, mechanics problems in daily life are discussed and analyzed. Seminar give everyone the chance to analyze the problem and provide feasible suggestion to solve the problem. Sometimes the problems are not easy to handle, at this time the teacher provide hint or guidance to make students to continue discussing, although the discussing process goes back and forth, if the offered scheme may deal with the key of the problem, then this group seminar of the problems is successful. Seminar is not only have the chance for everyone to make contributions to the discussing but also express the wisdom of all members of the group.

2. Reform of curriculum assessment

The assessment is set up to encourage students to learning continuously. The assessment plan should ensure students keep their enthusiasm for learning and not lose confidence during the entire learning process. Course assessment is an important part of learning process that should conduct in the course of teaching. Rational assessment plan can relieve the pressure of concentrated exams of the students, and keep the students daily learning rhythm moderately tight. Accumulative assessment is set up through analyzing and evaluating of the curriculum[6]. Accumulative assessment is composed of usual quiz, seminar score, final exam, additional mark. The same quiz questions is not exactly the same according to the different students. Seminar evaluation of everyone is composed two aspects of the score of the group and personal contributions in the group. Additional mark is given the students with outstanding performance in the learning process. Practice of reform of curriculum assessment proved that accumulative assessment make the students feel honor and accomplishment, improve the ability of learning independently.

3. Reform of Q &A

As the limited class time, it is difficult to carry on point-to-point communication with a wide range in class. Hence, the demands of learning of most student need other extracurricular methods to realize. Utilizing the technology of new media to build a bridge of communication between teachers and students. Setting up QQ group of Q&A, and study group of 3 to 5 persons for mutual helping and learning, is used to discuss and solve the puzzle of the knowledge. Meanwhile pre-class, between-class, after-class offline Q&A also conduct as the same purpose. In the communication process, pay attention to the students' views and opinions on things to develop ideological and political education. The representative problems of students in the learning process are discussed and guided in the QQ group by the form of text, pictures and video micro-class. The way of Q&A has received positive responses from the students, and the feedback during the final questionnaire survey is excellent.

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