

# Reform of Teaching Mode on Engineering Materials Foundation Courses for the Emerging Engineering Education Concept in Qingdao University of Technology in China

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**Abstract**—Instructing technique of Engineering Materials Foundation Courses have been proposed based on the reform of teaching mode requirements of emerging engineering education in Qingdao University of Technology (QUT) in China. The reforms include using of Moocs, Flipping classroom, and undertaking instructing approach and so on have been attempted to advance the quality of education of Engineering Materials Foundation Courses. The new methods accelerate the student's potential creation hugely. First, fresh attempt of educating technique is intended to the college student who were born in the 1990s and had specific character in contrast compared '70s' and '80s'. Secondly, know-how factors were reorganized and classified and logic link amongst the factors were cleared in exonerated to think about the utility of Moocs, reversed school room, task educating way. Final, the design of Moocs, flipping classroom and venture educating technique at educating Engineering Materials Foundation Courses and efforts with numerous instructing modes such as pre-class on-line path, type dialogue, case based totally teaches were proposed.

**Keywords**—Emerging Engineering Education; teaching mode reform; Moocs; Flipping Classroom; project teaching method.

## I. INTRODUCTION (*Heading 1*)

'Engineering Materials Foundation Courses' is an important major fundamental course for college students who are majored in mechanical engineering and material science engineering. During this subject, understanding the knowledge points which generally is utilized in applied science and process for instructing students. The connection of the applying, the chemical composes, the structure, the heating processing and also the mechanical overall performance of those substances area unit elaborate totally are important. The educating goal is that students need to achieve the fundamental ability including basic theory, the heating process way, attribute and also overall

functioning regarding the engineering materials. From this point, college students need to have the ability of analysis the way to recognize the material fairly in accordance to the utility surroundings.

The subject is the primary course for learning the following subjects such as 'Mechanical Design', 'Mechanical Principle' and so on. So, it is important for establishing the knowledge concern system of college students in mechanical engineering and material science engineering. Education goal for this problem is students' employment creation capability, executive capability, realistic capability, analytical ability and engineer quality [1]. Thus, it is very important to reform instructing approach in the issue of current educating methodology.

## II. EXISTENT MAIN PROBLEMS AND CHARACTERISTICS OF EDUCATION GROUP

### A. *Existent main problems*

In the existing content material products of the subject, determination, organization of knowledge deviated from the ordinary instructing design arrangement [2], which cannot afford the curriculum objectives. The mode of teacher-center should transform to students-center to motivate the active learning of the students. There were many shortcomings of teacher-center mode in educating style like slow updating of knowledge, lack of innovation and so on. It cannot meet the requirements of emerging engineering education. Moreover, the current main mode of teacher-center is the teacher in the classroom teaching, college students passively acquire knowledge. As a result, both teachers and college student feel exhausted, resulting in the cultivation of all-round ability goal cannot achieve.

### B. *Analysis of students group*

In this era, college students are all post-2000s, known as 'post-00s freshmen'. Compared with Post-80s and post-90s, the post-00s newcomers have their own unique features:

(1) their knowledge sources, acquisition methods are no longer limited to the content of textbooks, but different methods like Internet, radio, television applications could provide them with rich knowledge.

(2) Students born in early 2000s have great acceptance potential for many subjects and potential for active learning.

(3) Post-00s freshmen have a wide range of interests but the concentration ability on one thing is not enough. For them, profound reflection on unique topic, persistent reading of a topic is a challenge.

(4) Post-00s students' activities on a certain interesting problem ranks first. If the teacher cannot catch their attention, they would put their interests in wrong position, causing a bad psychological state in their mind and affecting their study. Thus according to the characteristics of post-00s students, transforming the teaching mode from teacher-center to students-center should urgently be solved, especially in the teaching of engineering basic courses. It is very important to reform the teaching style in current circumstance.

### III. REFORMING IDEAS AND METHODS

For post-00s students, new teaching modes such as Moocs [3–5], flipping classrom [6–8], self-determination way [9,10] et.al. instructing technique are all interesting and novel and easy to be accepted. The understanding new knowledge in challenge would be self-established. Logic link amongst knowledge points of expertise factors would be reconstructed by themselves. And the complete works about understanding would be established. After educating style reform, understanding ability of solving complex engineer problems would be improved and the study interesting of college students will be enhanced as the sense of accomplishment push them to study further.

### IV. PRE-CLASS LEARNING REFORMATION.

Because college students have a jagged level in acquiring knowledge and skills, it is impractical to expect them to master everything taught in class teaching [11]. Thus, in order to enhance the learning, the following educational strategies should be provided before class for college students.

(1) On-line training publications and tasks should send to students to prepare before class. The before-study materials including application of Moocs, smartphone app, Combine text, graphics and flash and so on. College students learn the knowledge before class can help them to grasp the key of the following class. They will create the know-how elements from the before-learn materials and bring the problems to discuss with teacher in class. The study quality will enhance compare with the traditional teacher-center mode.

(2) College students learn Moocs and App before class and are interested in understanding these factors.

(3) Hope to remind college students of some key knowledge in these media. When each online class is

ended, the questionnaire of students' coping with challenge factors should be wrote, so that teachers can know the knowledge master level of each student.

For example, according to the point-line-region sequence of Fe-C phase diagram, it is time enough to explain more comprehensively for the form evolution of each area or composition is presented to college student in class.

### V. KNOWLEDGE POINTS AND LOGICAL RELATIONSHIP

The Moocs mode usually use 10 to 15 minutes for a specific knowledge to attract the post-00s students' attention for a quick study. The knowledge system will be broken which makes the whole knowledge system lacking. It is very important for a teacher to reorganize the thematic know-how factors both in the Moocs, the software in the application and the class teaching.

The new professional knowledge system is usually separated into two parts of basic knowledge and application knowledge. The basic knowledge is designed for providing students with an understanding and mastery of relevant theory, which includes crystal and structure of metals, plastic deformation and recrystallization of metals, crystallization of steel, Fe-C diagrams, transformation of iron during heating and cooling, and heating processing know-how. By learning application knowledge, college students need the ability of improving their understanding of the basic knowledge of software and learning how to use the knowledge comprehensively. Improved their innovation cognition and innovation ability. Understand the logical relationship between.

Firstly, the essential knowledge points need to put forward as 'chemical compose, heat process and structure, organization and mechanical property, application'. Through this fundamental path, original information elements are mixed together, that is extremely beneficial to the students for the following study. In addition, when elements of software professional knowledge are learned, the main line of this stage is given to 'model grade, main application, comprehensive mechanical functional requirements, chemical element characteristics, heating disposal system and microstructure'. Figure.1 shows the Schematic diagram of rearranging knowledge points. It can be seen that the single professional point of elliptic icon, latent theme professional common-sense point of rectangular icon, and the linear icon are the logical relationship between these professional common-sense points.

### VI. APPLICATION OF FLIPPED CLASSROOM BASED ON DISCUSSION TEACHING AND CASE-BASED TEACHING.

Across pre-class study, college students had dominated many fundamental know-how fundamental knowledge points which put together for the foundation established. The fundamental knowledge points establishment assure the flipping classroom constructing. The flipping classroom is a teaching mode of students-center concept which takes college

students as fundamental part and the teacher as director in class teaching.

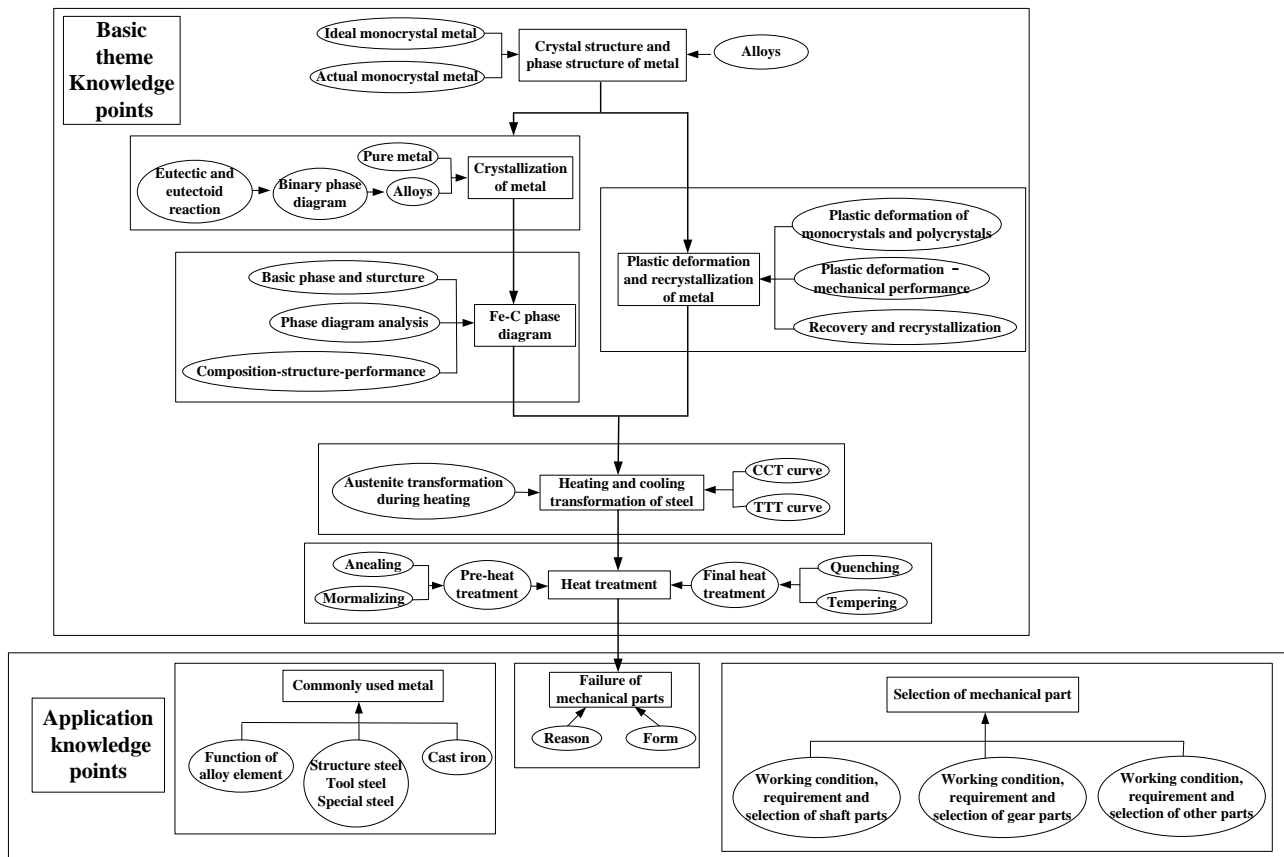


Fig. 1. Schematic diagram of the knowledge points

In flipping classroom, an important challenge of teachers was to help and guide college students to master the logic link of isolated professional knowledge elements, which ensures the extension of college student's information tips.

Taking influence of metal elements in steel on the comprehensive function of machinery as an example case, a full explanation based on cases could arouse students' interests on this point. This part will take the film of Titanic as an example of event teach. It was the most frustrating and memorable tragic event of the 20th century. Because most of students have seen the film, they will be inquisitive about the science elements when teacher evaluates the floating of this fairly large ship. In advance, Titanic was called "unsinkable ship". Because the ship design adopts divided cabin concept, even if one of cabins seeped by external impact, the other cabins will not seep at same time. Thus, when this large ship collides with different ship or iceberg, it will not submerge right now. Nevertheless, the giant ship sank into deep sea on its first trip. When they learned about this information, they were very curious about the reason for this event. The teacher needs to reveal the reasons from the elements of Materials Science: Titanic made-up of metal containing excessive sulfur element which will influence the materials quality in the low temperature environment. When the ship hits an iceberg, a large number of weak cracks occurred, causing the ice water flows into the

cabins and the ship breaks off and sinks quickly. After this event teaching, students will show a strong interest to study the elements' function and realize the importance of alloy elements to steel. Thus, flipping classroom teaching mode would fully improve students' desire for common sense and their browsing effectiveness.

## VII. PROJECT TEACHING METHOD AIMING TO CULTIVATE INNOVATION

Project teaching method is new teaching mode based on task driven to improve the engineering ability of college students. Task-based educating technique consists of these stages.

### A. project designing

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In carrying out the work, various elements need regarded completely:

- (1) Whether the project could assist college student applying learned knowledge.
- (2) Whether the task could help college students to understand the knowledge points.

(3) Whether the project has an effect in connect the contents before and after.

(4) Whether challenge could plot college student's learning interests.

(5) Whether task could enhance conversation, collaboration amongst college students all through venture directing class.

(6) Whether undertaking could encourage students use the discovered educational expertise to practice.

(7) Whether task is complete. Can they provide the finished products after project?

#### B. Carrying out project

In this section, there were quite a few steps need to be performed:

(1) Establish scene: Scene is the important step for the teacher to fulfil the task-based project which establish the environment in task instructing method. For example, when studying metal iron, college students will be asked to discover some familiar metals, including the lock, metal wire, the machine tool, the train, the plane, the engine and so on. Then to evaluation the attributes of those alloys.

(2) Task allocation. Students was divided into several groups with 5 or 6 students per group. Each group had their separate work. For example, one group could choose alloys made-up to distinctive mechanical components observed in laboratory, like shaft parts, gear, reducing tool, mould and so on. Next, for a given mechanical section, student teams would learn about the knowledge of evaluation the variety of metallic in accordance to essential line: 'chemical compose, heat process, shape, company, mechanical overall property, application'.

(3) Independent study. After teacher introduced operating surroundings, requirement of mechanical part, the basic scheme idea was put forward through group discussion. Teachers hope to help students discover, accumulate and promote reading resources.

(4) Cooperative learning. When assigning mission to students in task group, the teacher as an instructor should take into account the personality characteristics of each student and assign tasks to corresponding student. In this way, each student involved in challenge would try their best to complete the project.

(5) Solve problems. When project was over, student would acquire collectively to discover problem they encountered all during process. Through the dialogue with teacher, student can realize the inadequacy of their understanding mechanism, find higher level answers to problems.

(6) Strengthen and enhance knowledge. When the project completed, students should analyze how to enhance interior skills with the aid of absorbing the knowledge. And they will have the capacity to construct up their personal knowledge via connect separate knowledge with a logical line, and then be able to reflect and innovate. This takes a crucial function in future work.

#### VIII. SUMMARY

A reform of teaching mode with requirements of emerging engineering education in Qingdao University of Technology (QUT) has been proposed. The new teaching mode achieve the transform from teacher-center to student-center. the gaining knowledge of college student's passions were stimulated and the learning effectivity was enhanced. Through the reform including software of Moocs, flipping classroom, and task-based project teaching method, college student ability of gaining knowledge, creation potential has been expanded obviously.

The student characteristics of post-00s have been analyzed and the know-how factors were reorganized, labeled, logic link amongst the factors were exonerated for the adaptation of the software of Moocs, flipping classroom and undertaking instructing way have been put forward. The approaches for fulfil the teaching reform at instructing case of 'Engineering Materials Foundation Courses' are designed and carried out with the various instructing sample which include pre-class on-line course, category dialogue, event base totally teaches.

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