

Reform and Exploration of International Student-Oriented Course Construction

-Taking Engineering Drawing Course as an Example

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Abstract—With the development of the globalization of higher education, comprehensive English teaching of general majors and courses in colleges and universities in China is in extremely urgent need. Reform and exploration of the corresponding professional curriculum construction have been carried out. Taking course Engineering Drawing as an example, this paper summarizes the redesign and execution work of course construction and teaching implementation. The paper not only details the principles and the concrete teaching methods applied in the course construction and implementation process, but also conducts a questionnaire on students to collect feedback about the course from them. The implementation and feedback of the teaching activities in the past few years have confirmed the feasibility and applicability of the course Engineering Drawing for international students. In the end, suggestions on future course reform are put forward based on the experiences and lessons learned.

Keywords—*Engineering Drawing; Teaching in English; International Education; Higher Education*

I. INTRODUCTION

Zhejiang University of Technology (hereinafter referred to as ZJUT) is a comprehensive key university of Zhejiang Province, co-established by the Zhejiang Provincial government and the Ministry of Education. It offers programs in a variety of subjects including engineering, science, liberal arts, law, economics, pharmaceuticals, management, education and so on. As the advancement of internationalism strategy of higher education in China, ZJUT also set up international development strategy as one of the three long-term development strategies. The number of international student has increased greatly. At present, there are over 1,000 international students studying in the university, and the major covers engineering, economics, science, art, management etc., the level of degree includes undergraduate, master and doctor degree [1]. International student education has become an

important teaching task in our school.

Engineering drawing is an essential part of Engineering Design and crucial in the graphical communication skills of engineering graduates. Ability to produce, read and correctly interpret engineering documentation (including drawings) is critical for the successful work of professional engineers [2]. As a key compulsory course for all engineering majors, this course aims to cultivate students' spatial thinking ability, drawing and reading engineering drawings ability, and to enhance students' engineering practice ability and innovation consciousness. Course objective is to lay a solid engineering foundation for further curriculum design and graduation design.

"Engineering Drawing" is a compulsory course to international students majored in all engineering fields in ZJUT. Although "engineering drawing" has a long teaching history in ZJUT, but the course which is taught in English is quite new and facing great challenging. Exploration and reform on international-student oriented course construction is in great need to meet the demand of fast growing foreign student education. To explore and reform on the issue, the paper starts with analysis the present situation of teaching engineering drawing for international student in section II. Section III illustrates the exploration and reforms made in teaching engineering drawing course for international student in English. Conclusion and suggestion are given in section IV.

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II. PRESENT SITUATION OF TEACHING ENGINEERING DRAWING FOR INTERNATIONAL STUDENTS

A. Teacher's Development

Teachers are the researchers, designers, implementers, and appraisers of the main courses of curriculum reform. The curriculum reform is ultimately embodied in the teacher's education and teaching practice. No education reform can be successful without the active participation and support of teachers.

As the prerequisite and foundation for the course reform, teachers who has background with oversea studying and working experience were selected as member of the team for engineering drawing course for international students. Teachers who has both enthusiasm and English language skill are also welcomed to join the team.

Furthermore, administrative department of ZJUT also set up favorable policies which provide strong support for teacher's development and course construction. Some of the policies are (1) Special fund for teacher's oversea training programs. (2) English language training program. (3) Teacher Development Center holds seminar for experts and scholars from home and abroad to share and exchange teaching methods and experiences in particular fields.

With efforts from both teacher and university sides, teaching ability for engineering drawing course in English could be gradually improved, and this will ensure the implementation and teaching effect of the course.

B. Status of International Students

Students, as an important participant in teaching process, are vital factor to have an impact on the teaching process and results [3]. Since international students are from different countries or regions in the world, a more comprehensive understanding of students' language, education and cultural background, finding out students' learning objectives will do benefit to the implementation of the teaching process, and achieve curriculum purpose.

Currently, international students who took course "Engineering Drawing" major in mechanical, chemical, environmental, materials, computer, information and other engineering fields. Through survey, we found that international students could be characterized in following aspects: (1) Language background: International students mainly from Middle East and Africa, a few from Southeast Asia. Students' mother languages include English, French, Arabic, Russian, with various accents. Most of the students are able to communicate in English while a small amount of students have difficulties in understanding both English and Chinese. For those students, methods like electronic dictionaries, translation from their native language speaking classmate, etc. are used to help them better understand the course. (2) Educational background: Most of the students come from developing countries, and there's no entrance academic examination requirement for them. Under such situation, there exists a large gap of the knowledge structure and ability level among those foreign students. So during teaching process, teachers need to

design new teaching content and adjust teaching method according to the specific situation of students.

III. TEACHING MODEL OF ENGINEERING DRAWING FOR INTERNATIONAL STUDENTS

Taking industrial product drawings as research object, Engineering Drawing mainly focuses on the graphical representation, digital graphics information generation and graphics information transfer [4]. The course aims to equip students with following ability: (1) Able to understand the basic principle of orthographic projection and its applications; (2) Able to use two-dimensional drawings to express three-dimensional model; (3) Ability for spatial imagination; (4) Able to do creative design; (5) Able to do free hand drawing and ruler drawing; (6) Able to read and draw professional engineering drawings; (7) Develop basic awareness of engineering, standardization and regulations. In order to achieve the above course objectives, research and reform considering the classroom teaching, lab practice, curriculum assessment, questionnaire and students' feedback have been implemented, and will be illustrated in the following section, analysis and solutions will also be given for further development.

A. Classroom Teaching Methods

In order to deliver a lecture with good quality, variety of approaches is employed as following:

(1) Content rearrangement: Considering the language background, knowledge level and acceptability of international students, we have adjusted and reorganized the content, level, depth and breadth of the "Engineering Drawing" course. Through years of "Engineering Drawing" teaching practices, the full English multimedia courseware of "Engineering Drawing" has been completed. To help student pre-class preview and after-school review, not only bilingual teaching materials but also multimedia courseware is recommended to students.

(2) Combination of multimedia and blackboard (blackboard hand drawing) is applied in teaching course "Engineering Drawing" for international students. For new terms, standards, norms and definitions, power point is used to ensure that students could obtain information efficiently; and for product modeling and graphics generation, freehand drawing on blackboard is applied: This approach reflects teacher's thinking process more clearly meanwhile teacher could also adjust the speed according to the feedback of students to make the classroom more interactive, leaving more time for students to think, and better understand the modeling process, such that students cognitive process could catch up with teacher's explaining speed. By doing so, the performance in the classroom could be improved. Meanwhile, appropriate learning methods are provided to students. It's highly suggested that carefully review the contents of the previous lesson before class will lay the foundation for better understanding new knowledge. Wood mold, three-dimensional model and other

auxiliary means are widely used to help students understand the knowledge.

(3) Synchronization practice section: Consider the attention span of student, we set up synchronization practice section for each class when we prepare the lecture. Setting up this section in class, on the one hand, is to attract students' attention in class, to promote their active thinking, to ensure students could keep up with the teaching process; on the other hand, through hands-on exercises, it's easier to find a common problem among students which more efforts may be needed to solve problem.

(4) Discussion session: Discussion method is applied during the course. A discussion is the means by which people share experiences, ideas and attitudes [4]. Proper instructor guided discussion can not only promote students involvement in what they are learning, but also contribute to desired attitudinal changes.

B. The Organization of content under the guidance of course objectives and the effective delivery of lecture

Careful organisation of content helps student better understand and store and remember the knowledge. When developing a theme in a lecture, the instructor should use a variety of approaches. A useful principle in any instruction is to go from the known to unknown, from simple to complex, or from parts to a whole [5]. Take lecture content-reading views for example. According to the projection theory, using 2D views to express 3D model is one of the important contents of the course, while at the same time it is also the most challenge part for both the instructor and the student. As it is vital for the cultivation of students' spatial imagination ability. Therefore, in order to deliver lecture efficiently and effectively, specific methods are designed to help international students to enhance their understanding of this content, to master correct way of thinking and eventually develop spatial imagination. Decomposition of frame is one of the methods applied here. As showed in Fig.1, in order to imagine the shape of 3D model from given frame of Fig.1(d), steps for construction of 3D model are presented as following:(1)Construct cubic based on the given square as shown in Fig.1(a), and applying stretch operation which is perpendicular to the frame. All the students could do this step without any difficult. (2)Modify the dimension of height of given square while keep the topological structure of Fig.1(a) unchanged, think of the corresponding change of 3D model, as shown in Fig.1(b). (3)Reshape line into arc as shown in Fig. 1(c), imagine its 3D model. (4) Based on the former preparation, students could able to imagine the shape of the model, as its frame is shown in Fig.1(d). This method lay a solid foundation for developing student's spatial imagination ability.

In order to deliver content more clearly and achieve the best teaching effect, physical models, power point slides and 3D modeling software demenstrations have been fully used in the class in the combination forms of (1) theoretical introduction (text), (2) example demonstration (graphics,

models and animations), and (3) summary (text). Take reading views as example which is shown in Fig.2, how to imagine the shape of 3D model based on given views which are 2D wireframes is a great challenge for students. Shape analysis is the method for reading views, and its principle is described in Fig.3 using simple words like '(1)divide frames into subframes, (2)imagine 3D model for each subframe based on projection rule, (3)repeat (2) until all subframes are done, (4) combine all the models to a whole composite solid.' To read and understand this 4-step-principle won't be a problem, but how to apply this principle in solving questions always become major obstacle to the students. At this time, using 3D modeling software together with PPT to demonstrate the converting process of 2D wireframes to 3D solids (as shown in Fig.4), students could better understand 'dividing wireframe-projection-imagine a single part-synthesize the overall model' process. By doing so, the importance of sequence of making the construction of solid can be emphasized. And this could promote student's understand of content and help to reach course goal which is to develop imagination ability for student.

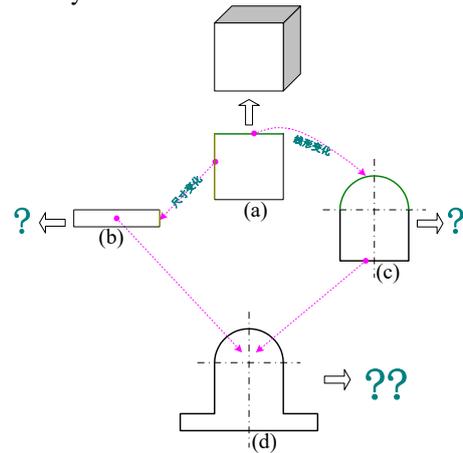


Fig. 1 Diagram of decomposition of frame

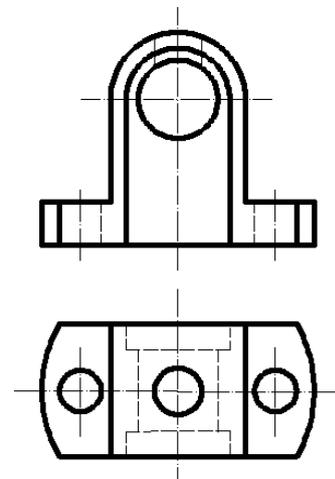


Fig. 2 Example of reading views

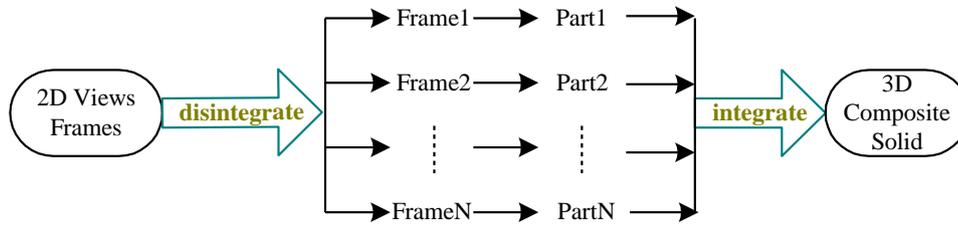


Fig. 3 Methodology shape analysis for reading views

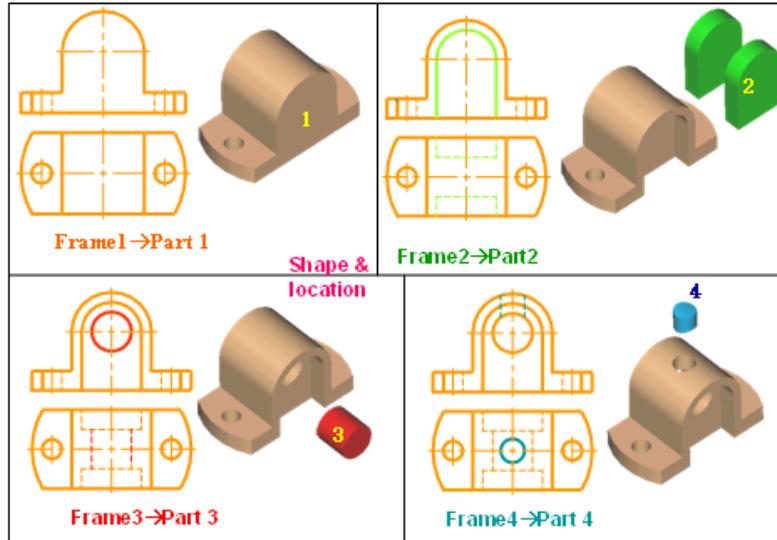


Fig. 4 Example of reading views using shape analysis

C. Lab practice

In order to better achieve the goal of engineering drawing, mechanical parts surveying and mapping has been set up as practical section. Through the practice, students could apply the theory into practice, improve the basic drawing skill, better understand national standards, and lay a solid foundation for subsequent courses. Fig.4 shows the students' drawings of mechanical parts surveying and mapping. Through practical section, students develop following abilities:(1) Get familiar with the usage of drawing tools, develop the correct drawing methods and skills; (2) Have better understanding of the expression of mechanical parts, dimension, standard parts; (3) Develop the ability to observe, analysis and solve problem; (4) During surveying and mapping, students also put forward problems considering design issues which lay the groundwork for subsequent courses.

D. Course Assessment

Consider the disparity of students' educational and language background, course assessment focus more on students' learning process. A comprehensive assessment system is designed which is composed of 6 parts: 15% for attendance, 5% for in class quiz, 5% for bonus point, 15% for assignment, 10% for midterm exam and 50% for final exam.

We hope that above-mentioned comprehensive assessment methods could help to promote students' participation in the

entire teaching process, to guide them active learning and to ensure the smooth and orderly implementation of the teaching process.

E. Questionnaire and students' feedback

Teaching evaluation is a process to judge whether teaching and learning is good or bad, and how is the actual result of the course, meanwhile, it's also a process of collecting and exchanging information and results between students and teachers. Furthermore, it is also used as an approach to judge and describe the value of the teaching activity [6]. To promote excellence and innovation, teaching evaluation is applied at the end of the course. Since the semester of 2013/2014(1), the English teaching practice of the course has been implemented and it has been practiced in nine teaching cycles so far. International students major in mechanical engineering, chemical engineering, environmental engineering, civil engineering, information and automation have taken the course. With the support from teaching reform funding, researches, explorations and practices on the course reform have been performed. By collecting questionnaires and communicating with students, the project team obtained feedback from students. Based on this, combined with teacher's self-reflection on course teaching, experiences and lessons gained from teaching practice were summed up.

'Engineering Drawing-Course Questionnaire' was designed and it has 24 questions mainly focused on two parts: 1.

Student's background. 2. Teaching and learning of 'Engineering Drawing'. The survey respondents were international students who participated in 'Engineering Drawing' English course during 2016/2017 semester. 35 questionnaires were issued and 26 valid questionnaires were retrieved. The effective rate was 74.28%.

Part1 of questionnaire is about student's background questions such as nationality, age, gender, Chinese and English level, education level before entering ZJUT. Part2 is about the teaching and learning situation of 'Engineering Drawing' English course, and they are divided into 5 categories as (1) evaluation of teaching progress of the course; (2) assessment of course difficulty; (3) assessment of teacher's teaching method and behavior; (4) self-evaluation and summary of the study; (5) suggestions and opinions to the course.

(1) Evaluation of teaching progress of the course

Fig.5 Shows the students' evaluation of teaching progress of the course: 77% of the respondents think the teaching progress is moderate, 19% think it is slightly faster and 4% hold that the speed is too fast. From this feedback, it can be said that after years of construction, adjustment and improvement of the course, the teaching progress of the course could meet the need of student.

(2) Assessment of course difficulty

Fig.6 shows the assessment of course difficulty: 38% of the respondents consider that the difficulty of the course is moderate while 50% consider the course has a certain degree of difficulty and 12% think the course is really difficult. The result may be influenced by various factors such as students' background, spatial thinking ability, efforts for the course, teacher's teaching effect and so on. And the results of the survey are basically in line with students' daily performance.

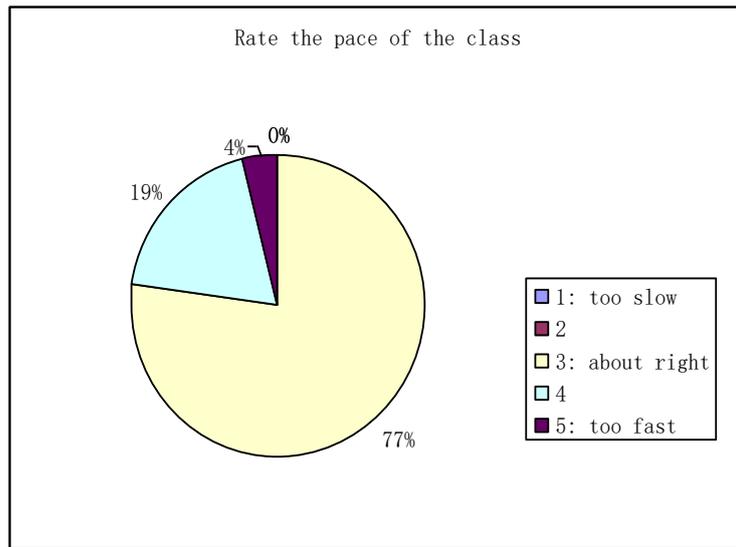


Fig. 5 Evaluation of teaching progress of the course

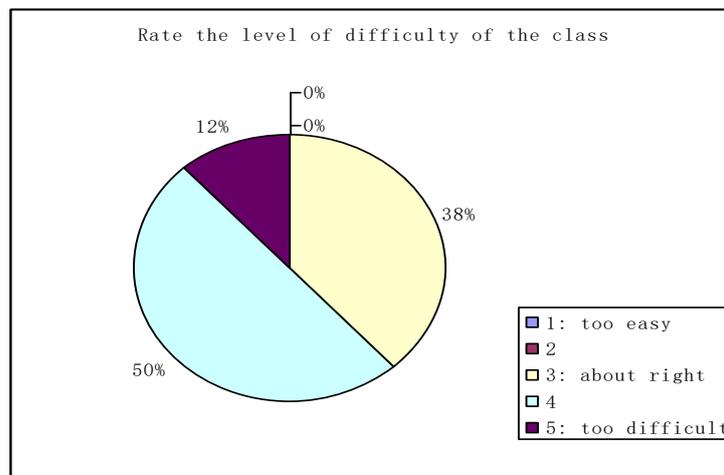


Fig. 6 Assessment of course difficulty

(3) Assessment of teacher's teaching method and behavior

The survey results show that the teachers have received high evaluations on the clarity of the lectures, effective guidance of student discussion, clear focus of instruction, adequate preparation of lessons, encouragement of students to raise questions, adjustment of lecture properly, and help for students' learning. Lack of tutoring after class is one problem and request from the survey. Reasons for this problem may have some objective factors. ZJUT has multiple campuses located at different parts of the city, teachers have to rush to other campus for activities like teaching or research work, which limits the after class tutoring time. To solve this problem and also to meet students' need, TA (teaching assistant) system shall be employed and it may be a good solution.

(4) Self-evaluation and summary of the study

90% of the respondents believe that go to the class, listen to the lectures and finish assignment on time are prerequisites for the course. 95% of the respondents agree that the amount of assignment is moderate. 100% of the respondents think that the mid-term exam is necessary and 95% believe that teaching methods like freehand drawing on blackboard and 3D modeling software usage are of vital help for students to better understand of the knowledge.

(5) Suggestions and opinions to the course

36% of the respondents suggested that study group will do benefit for them to better master the knowledge while 11% thought that they could solve the problem more effectively on the blackboard under the guidance of teacher; 20% of the respondents wrote that university should provide more lecture books and exercise books related to the course for reference after class.

IV. CONCLUSION

As globalization of higher education goes forward, there's urgent requirement for improving the quality of higher education. Teaching reform and course construction is one of the efficient ways to meet that demand. Under this context, ZJUT has implemented curriculum reform in internationalization construction of mechanical engineering, chemical engineering and other engineering majors.

Take course engineering drawing as example, this paper summarized the reform and exploration work of course

construction and teaching implementation. The paper not only introduced in detail the principles and the concrete teaching methods applied in the curriculum construction and implementation process, but also made questionnaire to students and collected feedback from students about the course. The implementation and feedback of the teaching activities in the past few years have confirmed the feasibility and applicability of the course "Engineering Drawing" for international students. At the same time, the experience and lessons learned from the teaching practice in the past few years have put forward a new direction for the reform and practice of the English course "Engineering Drawing": (1) Improve construction of teaching resources, provide online course, (2) Establish teaching assistant system: hire graduate student as course tutor. (3) University library should purchase more English text books and exercises books in this field for students to use. (4) Apply Chinese-International students mixed class system: on one hand Chinese student could improve their English communication ability, on the other hand, international students can learn from Chinese students. Win-win situation could be reached at the end.

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