

Bilingual Teaching Experience in Engineering Graphics and Suggestions for Quality Enhancement in Future

Cheng Chen*, Qin Zhongbao, Li Yanjiao, Lv Hailiang, Chen Qiang

Xi'an Institute of Hi-Tech
Xi'an, ShannXi, 710025, China
Email: cche943@sina.com

Abstract—The aim of this paper is to summarize the bilingual teaching activity in Engineering Graphics which was held in the institute in the first time, and propose some suggestions that can possibly bring progress in the future. The authors of this paper summarize this activity in terms of students' academic background, lecturing mode, course contents, formulation of customized textbook and exercise book, exercises and assignments and final examination and scores. Based on the recorded teaching activity, corresponding suggestions to enhance the teaching quality potentially are made for each aspect, such as classification of students from different academic background, assignment evaluations, etc. Specifically, the introduction of 3D software into class is emphasized. The progress can be made in the future from those provided suggestions which are feasible potentially.

Keywords—Bilingual Teaching; Engineering Graphics; Teaching Activity Recording; Suggestions for Quality Enhancement; 3D software.

I. INTRODUCTION

Engineering Graphics is a critical course for the first year's students, specifically, for those in engineering like mechanical, civil, electrical, computer engineering. In recent years, bilingual teaching in this course is appearing frequently in universities in China, the research on it is also quite popular [1-4].

In the first semester of this year, the first author of this paper attended the bilingual teaching course in Engineering Graphics as the English translator in the institute. What has been done includes three parts: preparation before lecturing, lecturing, and assignments and final examination evaluation after every lecture. During this direct face-to-face teaching process, we have gained some teaching experience in this course, which was actually released in its first time in the institute. The goal of this paper is to record what has been done, summarize mistakes and errors made inside it, and most importantly, make some suggestions which could possibly raise the teaching quality in future. That is to say, students can learn in a more convenient environment, master the knowledge inside the textbook and apply what has been obtained into practice creatively. In the same time, lecturers and administrators can avoid the mistakes made before, boosting the teaching efficiency.

The remaining of the paper is organized as follows: firstly, the complete bilingual teaching process and experience in Engineering Graphics in the first time in the institute was described in terms of six aspects which are tightly related to the bilingual teaching. Then, suggestions are made that can possibly increase the teaching quality in future.

II. COMPLETE BILINGUAL TEACHING PROCESS AND EXPERIENCE

A. Students' academic background

All the teaching behaviors including the contents and methodologies should be based on students' academic background. The level of difficulties should be a little higher than students' average performance. To this end, the contents should neither be oversimplified nor too hard, in which circumstance students can pick up the knowledge in a satisfactory and suitable manner. In this bilingual teaching activity, the course was open to all undergraduate students. Then students from diverse professions including engineering, science and arts chose this course. Specifically, most of the students major in mechanical engineering, material science, physics and English, etc.; however, students in engineering have learnt in this course in Chinese already in their first year in university, who attended this course to immerse them in the bilingual atmosphere, rather for the contents and knowledge inside this course. In contrast, arts students do not have any background about Engineering Graphics. They came to this course for the sake of language. Actually, this situation is a dilemma and challenge to lecturers, who were not easy to measure the level of difficulties in teaching. In the meantime, students who had learnt this course in Chinese seemed to waste their time due to the repeated contents, but arts students seemed to be very hard to keep on the pace in classroom, for the abstract imagination in three dimensions. Even so, all students still concentrated on the contents lectured in classroom.

B. Lecturing mode

There are two lecturers in classroom, one of whom describes the contents and knowledge in Chinese and the other translates what the first lecturer said and wrote into English immediately after the completion of each sentence in Chinese.

In this way, the actual lecturing time in Chinese or English was only half of the total lecturing time.

Power point slides and blackboard with chalks are used together to show contents including definition, graphics, animation etc. to students visually. Because of the tight lecturing time, most of the contents are formatted exhibited directly in slides, only structures of a course are presented and emphasized on the blackboard to indicate the teaching process. That is to say, lecturers did not draw figures strictly and comprehensively on the blackboard as they lectured to students only in Chinese. In contents which were quite abstract and hard to imagine, scratches were drawn on the blackboard to show the drawing process necessarily.

C. Course contents

To ensure the completeness of this course, contents in the textbook formatted by the authors of this paper and presented in the class include seven chapters, which could be found in most of textbooks in Engineering Graphics in China. Considering the limited teaching time for lecturers and reviewing time after class for students, contents are the most essential parts in this course, i.e., elementary knowledge in Engineering Graphics, orthographic projection methodology, basic and composite solids, basic principles of drawing, standard and commonly used parts, detailed drawings and assemble drawings.

D. Formulation of customized textbook and exercise book

The textbook and its corresponding exercise book were formatted by the authors of this paper, by referring those available in the market. One of the primary references was Engineering Graphics (2nd Edition) written and published by ShenZhen University and China Machine Press, respectively. It is a bilingual textbook and is widely applied in China. Based on the teaching program such as lecturing time, level of difficulties and so on, some of the primary chapters are adopted and modified to be more suitable to the bilingual teaching in the institute. Database of exercises in Engineering Graphics has been built via teaching activities in the past years. The exercise book was written in accordance with the contents of the textbook, by abstracting related exercises in the database. Generally, the level of difficulty of exercises is a little higher than average.

E. Exercises and assignments

Homework after class includes exercises in the exercise book and assignments. The former can be done directly in the exercise book, while the assignments are drawn on A3 papers, via the synthesized utilization of drawing tools, i.e., T-shaped rules, triangles, compasses etc. Assignments were important to verify students' performance and how they mastered the theoretical knowledge and their capability in putting what had been learnt into practice. The scores in assignments were also tightly related to the final score in this course, weighting 30 percent.

F. Final examination and scores

The level of difficulty in the final examination was controlled on a level which is neither too hard nor too easy. That is to say, students who were actively involved in class and finished homework and assignments were able to get a satisfactory score. On the other hand, considering the art students who had no foundation in engineering, not to mention Engineering Graphics, some parts of the examination were copied directly from exercises questions with or without minor modifications. The final score was the weighted sum of score in class performance, assignments, and final examination, to ensure most of students can pass that course. More importantly, a positive attitude was maintained among students in this course.

III. SUGGESTIONS FOR POSSIBLE IMPROVEMENTS

The abovementioned six aspects were the comprehensive description of the bilingual teaching activity in Engineering Graphics which was firstly attempted in the institute. Some experience was gained through it, which could possibly lay a foundation and contribute to the quality enhancement in bilingual teaching in the future. The following aspects are about the summary of our thoughts and experience for future development in bilingual teaching in this course.

A. Course setting for engineering students in the first year in university

As a newly developed course in the institute, it was compulsory to all undergraduate students. However, some of current students attending it had already learnt this course in Chinese during their first year as a freshman, whilst some students are majoring in arts and do not have any foundation in engineering. This situation in students' academic background really challenges lecturers in terms of textbook formulation, contents' level of difficulty, class manipulation, final examination evaluation etc. Therefore, it is suggested that it can be set as the fundamental and compulsory course for first-year students' who are majoring in engineering, rather than a course open to all undergraduate students. Though it is harder than teaching in Chinese only as usual due to the reason of language, students can benefit from it due to the moderate requirement increase. Also, the first-year's students have a solid foundation because they just passed the College Entrance Examination.

B. The improvement of lecturing modes and lecturers' collaboration

In this first bilingual teaching in Engineering Graphics, two lecturers spoke Chinese and English, respectively. They could collaborate better from the following aspects: in the first place, some contents are quite simple, the language translation was also easy and the process is short; however, some parts are rather complicated, then graphics, drawings, notations and text descriptions are combined together frequently to express the meaning inside. Then this process is quite time-consuming, and students spend more time in learning. Correspondingly, the translation process into English is also not simple and a certain amount of time is required. In this regard, it is not easy to

control the set-points in time through the whole class. Before the class, two lecturers should spend more time to prepare their collaboration, in terms of length of every translation, the ways in lecturing, etc. A feasible method for a good preparation is formatting words to be spoken in the class, just like actors and actress' lines in TV series or movies in a notebook. The whole frame, titles and subtitles for one class should also be noted. The time for each translation and its original expression in Chinese should be managed well. To make this, lecturers should be familiar with contents in textbooks and teaching principles and regulations, specifically, the possible difficulties encountered in class by students. Those are usually the most time-consuming parts in a class. To make the continuity and consistence in class, more lecturing methods and modes are to be created.

In the second place, even though the contents in this course is quite objective, two lecturers still have some contradictions in some parts of that book, in terms of a certain problem's description and understanding, especially about some complicated parts. In this regard, one huge assumption can be made, where this course is lectured in English only by one lecturer. If so, the lecturing time is doubled than that in the first time about bilingual teaching, and fewer contradictions will be produced. When complex contents are encountered, the lecturer can speak both Chinese and English to make the contents better understood, combined with other teaching tools such as graphics and drawings in power point slides.

C. The adoption of textbooks

The textbook in the teaching was formatted by mainly referring to that as mentioned in Section 2.3. Despite the clear structure and comprehensive description inside it, it is quite theoretical and conceptual. That is to say, more descriptions of theory than the practical utilization of them are formatted. From our point of view, Engineering Graphics is a course which is quite practical in engineering, what have been taught in class should be set into practice to see their great roles in reality. It is known to all that textbooks are better from developed industrial countries in America and Europe, no matter in depth or width. Also, generally more case studies and practical examples are formatted in them. In these regards, some international textbooks have been introduced into China already and can be purchased availably online, which are listed as follows [5]

- Engineering Drawing and Graphic Technology, 14 edition,
- Fundamentals of Engineering Drawing, 5 edition,
- Technical Drawing, 12 edition,
- Engineering Design and Graphics with Autodesk Inventor®
- 1 Mastering CAD/CAM.

We can also try to choose some of them as our textbooks in the teaching activity. The contents to be taught or on self-learning can be chosen based on the teaching time and students' level in engineering learning and their future applications.

D. Classification of assignments and homework

It is vital importance to develop students' practical skills in learning this course, which is elementary in engineering. To this end, students finish their assignments and homework independently, reflecting their capability in drawing engineering graphics. The amount of those homework and assignments should reach up to a certain amount to strengthen the engineering skills. However, from the assignments and homework handed in to the lecturers, obviously, some students had copied others' work. Via the communication after class with these students, it was found that they did know it is wrong to behave in this manner, but due to the tight time after class and the weak foundation in engineering, they copied some parts of the assignments. From the viewpoint of the authors, despite those reasons which really exist in their university life, it is an important skill that balancing the weights among different tasks, and it should be formed as a habit in daily life. If they tried their best to build it from the elementary course, studies will be easier in the following years. More importantly, they are able to face challenges and difficulties in future life in a successful manner more frequently. To avoid this phenomenon in future's teaching and learning activities, and considering the huge amount quantity in exercises, we authors suppose that exercises in the formatted exercise book can be classified into different groups, i.e., different student groups do their responding exercises. For the assignments which are large tasks for first year's students, one group of students finish together one assignment, but different parts of it. This can also cultivate the collaboration spirit among them, which is an important character for engineers. Via these classifications, there are no a same homework or assignment for any two students. However, it also challenges lecturers by bringing a big burden for their work in correcting and evaluating such a large amount of different homework and assignments. A possible solution to this can be like this [6]: lecturers only format rules and regulations for correcting homework and assignments, students in a same group judging their peers' tasks. To ensure a justified evaluation among students, their signatures are to be exhibited on their peers' drawing papers.

E. Teaching and learning computer-aided three-dimensional software

For technicians and engineers who have been in their job careers, computer-aided design and drawing are quite convenient and critical. However, traditional teaching methods and contents were exhibited obviously all through this bilingual teaching activity. We authors stressed a lot on the theoretical knowledge in class used the two-dimensional figures to express the 3D mechanical parts and components. Homework and assignments were relying on classical drawing board and tools like compass and rulers. In contrast, in the era and time, almost every technician and engineer draw 3D figures in manufacture industry by virtue of the aid of computers and related software, such as SolidWorks, ProE, UG, AutoCAD, etc. We authors firmly believe it is important to bring a kind of 3D software like SolidWorks into class. The evident benefits of this manner are as follows:

1. Due to the direct and easy observation of graphics from any different perspectives on the computer's screen, the

abstract and difficult concepts, such as orthogonal projection principle, basic views, sectional views, section lines and intersecting lines, where a deep thinking and imagining is needed will be much easier than before, which greatly alleviates the learning difficulty and boost the learning efficiency.

2. From the brief description about SolidWorks in the class in this time's teaching activity, we lecturers found the huge interest from students about that software, due to the vivid color on the components and the comprehensive exhibition of modeling process for parts and assemblies in the computer.

3. A good and firm mastering a computer-aided 3-dimensional software tool will no doubt lend students an edge in finding their satisfactory jobs after graduation.

It is known to all that it is not hard for people to be familiar with that software. If the class is interested in it, students are encouraged to get the certification as assistant engineers in computer-aided 3D design and drawing, which is held every year by the company which releases Solidworks. That certification will be a second strength shown on their CVs. It is noted that 3D software study in the class of Engineering Graphics is quite now popular in China[3 , 7].

IV. CONCLUSION

The bilingual teaching activity in Engineering Graphics which was released in its first time was summarized in terms of students' academic background, lecturing mode, course contents, formulation of customized textbook and exercise book, exercises and assignments and final examination and scores. Specifically, drawbacks inside are recorded, which are to lay a foundation and exhibited as a benchmark for further improvement in the same course in the future. Suggestions are

made for corresponding aspects to possibly make them better. The value of this paper is it is actually a combination of summarization about the bilingual teaching activity in Engineering Graphics which was held in the institute in the first time, and experience that could contribute to a progress to be made in the future.

ACKNOWLEDGEMENTS

The authors sincerely acknowledge the valuable time and efforts from anonymous reviewers.

REFERENCES

- [1] Zhu Keqian, Acheson Douglas, Yuan Huixin, Liu Shanshu, Ding Jianning, Yuan Ningyi, The Deep Insight Into the Engineering Graphic Courses of IUPUI, *Journal of Graphics*, 2017, (5). (In Chinese)
- [2] Xiaoying Ding, Course Reform in Engineering Graphics based on the professional cpability improvement of student, *University Education*, 2018 (5), (In Chinese)
- [3] ZHANG Lingling, ZENG Xiangguang, Research on Teaching Reform of Mechanical Drawing Based on Solidworks, *Machine Building & Automation*, 2017. (6), (In Chinese)
- [4] Dong Yougeng, Xu Guangshen, Shang Yulin, Yang Chengtao, Reference and Reflection on Curriculum Design of Manufacturing Mechanical Engineering in University of Gottingen, *EDUCATION TEACHING FORUM*, 2017, (51). (In Chinese)
- [5] Zhuang Hongquan, The publication practice on bilingual text books for engineering graphics, *Journal of Graphics*, 2012, (3). (In Chinese)
- [6] Zhang Xuechang, Shi Yueding, Wu Hongbin, Xu Shaofeng, From Be Passive to Be Positive: Reform and Application of Assignment Evaluation Modes for Engineering Graphics in Mechanical Engineering Students. *University Education*, 2016. (11), (In Chinese)
- [7] Zou Bo, Chen Ping, Wan Jing, Innovation of Bilingual Course in Engineering Graphics from the Viewpoint of Students, *Education Teaching Forum*, 2016. (29), (In Chinese)