Teaching Reform of Polymer Material Molding and Processing Course

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Abstract. Higher education is an important symbol of national development level and development potential. Therefore, we must constantly improve teaching quality by reform and innovation. The mode of flipped class is adopted in the course of Polymer Material Molding and Processing. A lot of effort and reform are put into both online class and offline class so that students can learn more knowledge and acquire the ability to solve practical problems.

Keywords: Polymer material molding and processing · Teaching reform · online class · flipped class

1 Introduction

Influenced by the thinking of traditional education, there are many problems in the current course of polymer material molding and processing: Teaching is still based on the offline classroom lecture; and there is little interaction between teachers and students/between students and students, resulting in unsatisfactory learning results.

On the other hand, the development of times requires students possessing the ability to solve practical problems, no more than the basic knowledge. Polymer material molding and processing is an important means to obtain polymer products, to show material characteristics and to develop new material [1]. It is very important for students to learn the knowledge and technology of the course well.

1.1 Basis of Reform

According to American scholar Edgar Dale's "learning pyramid" theory [2, 3]: lecture, reading, audio-visual and demonstration belong to passive learning, the average retention rates of learning contents is 5%, 10%, 20% and 30%, respectively; while discussion, practice and teaching others/immediate use of learning belong to active learning, the average retention rate of learning contents is 50%, 75%, 90%, respectively.

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2 Reforms and Implementation

2.1 Selection and Classification of Course Contents

"Polymer Material Molding and Processing" (the 3rd edition) compiled by Tang Songchao is used as teaching material. However, the chapters in the book that are repeated with other courses are not included in the scope of the course. Similar contents in the book would be lectured once, in order to save class time for the latest technology and achievements. Taking "extrusion molding" as an example, the chapter focuses on both the extrusion molding of thermoplastic polymers and the differences between the extrusion molding of thermoplastic polymers and thermosetting polymers, while the similar between them is neglected.

According to the characteristics of polymer material industry in South China and social development needs, the latest technology and achievements of polymer material molding and processing is added to the course contents in order to broaden students' horizons and stimulate their interest in learning.

The above contents of the course can be divided into three categories. Category A includes basic concepts, general knowledge and some relatively simple contents, which can be learned by students via online learning (Chinese University Massive Open Online Course, MOOC). Category B includes the knowledge that is difficult to grasp by students' self-study only via online learning. The contents are learned by way of both online self-study and offline classroom lectures. Category C includes the knowledge that are not easy to be grasped by way of both online self-study and offline classroom lectures, such as the effect of injection conditions on product properties. The contents are learned by the mixed mode of online class, offline class and practice. The advantage of the mixed mode is that students can immediately use the contents learning from MOOC and offline lectures.

2.2 Design and Implementation of Online Teaching

With the development of information technology, online class has become an important way of undergraduate teaching. Students can transcend the limitations of time and space, and use portable electronic devices to independently learn anytime and anywhere. In order to obtain the best learning results, the design and preparation of courses in advance is particularly important.

1) Pre course preparation

The teacher selects suitable course resources from MOOC base on the revised course contents. For the contents that cannot be covered by MOOC, the teacher can make micro-lessons by recording short videos. The above two methods assist students to complete the self-study before the offline class. The lecture notes, cases required for practical

teaching, chapter guidance, homework and questions in test should be prepared before the course starts.

2) Students' self-study
Students can understand which contents should be learned and learning methods of every chapter through the chapter guide sent by the teacher via "Changjiang Rain Class". Then students learn the course contents by watching short videos and complete homework and test questions. Students can also tell the teacher about the difficulties they encountered in the process of learning by leaving messages or clicking the "don't understand" button.

3) Evaluating of students' self-study effect
Teachers can obtain students' learning results by checking the duration and times of watching videos, scores of test and questions raised by students. During offline class, teachers focus on the highlights and difficulties of the course, as well as the questions that most of students could not answer correctly in test.

2.3 Design and Implementation of Offline Classroom

Flipped classroom refers to a teaching form in which students use digital materials (audio and video, electronic textbooks, etc.) distributed by teachers to learn course contents independently before class, and then participate in the interactive activities of peers and teachers (such as interpretation, puzzle solving, inquiry, etc.) and complete exercises in class [4, 5].

The reform of Polymer Material Molding and Processing course in offline is as follows: Firstly, for the knowledge that are difficult for students to grasp via online self-study, the various teaching modes, including group discussion, case teaching method, video display, explanation in drawing, doing exercise etc. are adopted to help students to learn in offline classroom. For example: the theory of solid transportation in extrusion molding is abstract, and there is much theoretical derivation. Even if lecture is repeated in offline class, the learning results of students may not be good. Instead of lecture in offline class, a multi-choice exercise as shown in Fig. 1 is displayed during the offline class. The teacher encourages students to discuss in group according to the theoretical knowledge they have learned, and then lets students find out the correct answers. It is worth noting that the teacher only plays an auxiliary role in the above case.

Secondly, Category C includes contents that could not be grasped by the methods used in Category A and B. The contents in Category C is learned by the mode of practical

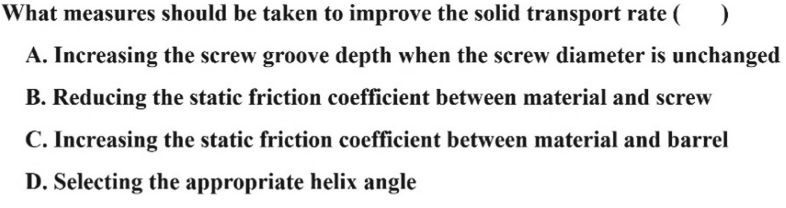

Fig. 1. A multi-choice exercise (Owner-draw)

Table 1. The relationship between the comprehensive training contents and the knowledge points (Owner-draw)

The comprehensive training contents	The knowledge points
to select the appropriate polymer raw material according to the molding machine	content of Polymer Materials Science
to adjust process conditions to prepare products with different appearance and performance	influence of process conditions on the performance and appearance of products
to prepare a film by a blowing machine using polyethylene; to prepare a film by a casting machine using polyethylene; to test the properties of the two above films.	the properties of product prepared by different molding methods are different even if using the same material. This is the engineering characteristic of polymer materials, i.e. the properties of polymer products not only depend on the properties of the materials themselves, but also greatly are affected by the additional properties produced by the molding process.

teaching. The following is an example: How to solve the defects of injection molded products. First of all, the teacher does experiments before offline class to ensure the smooth progress of the practice class. During the offline class, the teacher organizes the students to discuss the causes of product defects, and requires students to propose the possible solutions. Then with the help of the teacher, students use the injection molding machine to remake a product to verify whether the solution proposed earlier is effective. Finally, the learning result is further consolidated by homework after class. The detail is that students work in groups to solve the other defects of injection molding products. Each group will complete different question using the method learned in offline class, and submit assignment in the form of report. Students evaluate the other groups' assignment according to the scoring rules and reference answers provided by the teacher. During the evaluation, students can learn the solutions of other groups. Such teaching methods not only help students understand the contents in Category C better, but also cultivate students' ability to solve problems by using the theoretical knowledge they have learned.

The traditional teaching often includes a two-lesson general revision at the end of the term so that students understand the course contents better. Actually, the method can't achieve the same effect as expected. Comprehensive trainings instead of general revision are used at the end of the Polymer Material Molding & Processing course. For example, students are required to make films using a casting machine and a blowing machine respectively. The detail requirements include selecting the appropriate raw materials, changing and selecting the process conditions, testing the properties of the film. Table 1 displays the relationship between the comprehensive training contents and the knowledge points. Through comprehensive training, students can integrate theory with practice and improve their ability to solve practical problems, which is also the original intention of our curriculum reform.

3 Conclusions

Compared with the course before the reform, the course elaborated in the paper has the following characteristics: Relying on the excellent and rich online teaching resources, students adopt the active self-learning mode to learn the polymer materials molding processing contents. Compared with the traditional mode, the self-learning mode will enable students to grasp more contents. Through group discussion, doing exercises, report and other modes, the reformed course improves students' participation in teaching, stimulates students' enthusiasm in learning, and enables students to learn more actively. Through the hands-on operating, discussion with group members and correcting each other's homework, the students can grasp the knowledge and technology more firmly, thus further improve their ability to solve practical problems.

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References

1. S.C. Tang. Curriculum Construction and Teaching Reform of Polymer Material Forming and Processing, Chemical Engineering Higher Education, vol. 1, 2008, pp. 25-26.
2. Y.L. Jiang, T. Xu. Application and Practice of Learning Effectiveness Pyramid Theory in Flipped Classroom, Chinese Audio-Visual Education, vol. 7, no. 330, 2014, pp. 133-138.
3. Y.F. Wang, X.C. Zhang, T Fang. Practice of Physical Chemistry Laboratory Teaching Mode Reform Based on the Learning Pyramid, University Chemistry, vol. 32, no. 12, pp. 25-30.
4. Y.J. Zhang. Flipping Classroom Reform, China Information Technology Education, vol. 10, 2012, pp. 118-121.
5. J.P. Guo. Flipping Classroom Teaching Mode: Variant-Unification-Re-variant, China University Teaching, vol. 6, 2021, pp 77-86.