



Curriculum Teaching Reform of the "Signal and System" Based on Transfer Learning

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Abstract. "Signal and System" is a professional core course for electronic information engineering. According to the teaching characteristics of this course, combined with the actual teaching of the Shandong Management University, a series of teaching reforms were started from the aspects of curriculum content, school arrangements, teaching methods, practical links and assessment methods. Looking forward to displaying the content of the curriculum with richer teaching methods in a limited course, maximize the enthusiasm of students, and enhance the students' construction of the overall curriculum framework. According to the results of the evaluate and the final exams, the reform of "signal and system" has improved the quality of teaching.

Keywords: Signal and system; Teaching reform; Transfer learning

1 Introduction

Since the 1970s, research on "signals and systems" has been popular in colleges and universities. After more than 40 years of development, the course content has become perfect. However, how to impart the content to students better and more effectively, and how to carry out practical reform on the course that emphasizes the theoretical derivation of formula are still the difficulties of curriculum reform. So far, there are many studies on the teaching reform of this course.

Rong Hena et al.^[1] conducted an application-oriented exploration of curriculum teaching, combined curriculum theory with practical applications, introduced different levels of application examples at different stages of teaching, and promoted students' understanding of theoretical knowledge. Gao Zhiyuan et al.^[2] conducted signals and system curriculum teaching reforms in the direction of theory and practice, attached importance to the teaching of basic theory and basic concepts, and at the same time diluted calculation formulas and promoted joint assignments. Wang Lili et al.^[3] used the cultivation and improvement of practical ability as the goal of signal and system curriculum teaching reform. Through optimizing the curriculum structure, using driving classroom teaching and computer-assisted teaching, the teaching reforms has achieved good results. Wang Xia et al.^[4] stimulated students' enthusiasm by constructing CDIO projects, and cultivated students' ability to discover, analyze, solve and

work in teams. Liu Wann^[5] used Matlab's powerful signal processing function and the GUI graphic user interface tool to develop the visualized experimental teaching platform based of "signal and system" course based on MATLAB, combining traditional teaching with modern teaching, and incorporating rich cases into the teaching process to improve the quality of teaching.

Previous people put the reform focus on a single issue such as improving the level of practice, stimulating students' interest, and adjusting teaching content. In response to the above issues, this paper explores new teaching methods. On the basis of strengthening the theory of signal and system concept, transfer learning is realized by means of comparison, combination of online and offline, combination of theory and practice, etc. In the limited class hours, more abundant teaching means are used to display the course content, maximize the enthusiasm of students, enhance the construction of the overall course framework of students, and achieve better assessment results through various assessment forms

2 Curriculum Reform

2.1 Curriculum Reform Measures

2.1.1 Course Content Update.

The content of the curriculum in traditional teaching is more abstract, and there are many formulas and theoretical derivation, which leads to the boring content of the curriculum, and the enthusiasm of students for learning is lower. At the same time, students lack the construction of the overall curriculum framework and the overall connection with the relevant curriculum content. On this basis, the course content will be updated.

- According to the characteristics and foundation of students, appropriately delete complex content on the premise of ensuring normal teaching content;
- Compare the previous courses and the existing courses, and delete the duplicate content;
- According to the content and characteristics of the course, find out the content with appropriate difficulty, similar analysis methods and suitable for students' self-study and transfer learning, and let students learn independently.
- According to the course content, relevant cases which are grouped according to the degree of difficulty are added to the course layout. Classic cases are explained in class, simple cases are used as preview content, and complex cases are used as group cooperation projects after class.

2.1.2 Flipped Class.

In traditional teaching, it is mainly taught by teachers, and students' participation is not high. In order to improve students' classroom participation and enhance the application level of knowledge, the "flipped classroom" is applied to the teaching process. Through this method, students are actively involved in classroom teaching, and

knowledge imparting is regarded as a two-way interaction between "teaching" and "learning". Teachers give full play to their role in guiding, helping and motivating students' learning, and make good use of inspiring and inducing methods to stimulate students' learning desire and interest.

- Classify the course content in accordance with the analysis method;
- The teacher selects the part of the same analysis method to explain the representative content;
- Students will flexibly use the methods and knowledge they have learned, and use the time after class to learn relevant knowledge independently in small groups and explain it in class.

2.1.3 Combination of Online and Offline.

There are many teaching contents and few teaching hours, so it is difficult to better understand and master the course content only by using the time in class and the form of teaching by the teacher. Therefore, in order to better improve the learning quality of students, online and offline learning can be combined.

- The learning content is divided according to the degree of difficulty. For the more difficult content, online resources can be used to preview, and then targeted learning can be carried out in class, so as to improve learning efficiency. The content with low difficulty and the extended content are studied independently by the students after class using the network resources and the resources published by the teacher.
- Teachers use the rain class to issue tests to check students' independent learning results;
- The teacher makes supplementary explanations in class according to the students' test situation.

2.1.4 Combine Theory with Practice.

The traditional teaching method is relatively simple, and the result of signal analysis and system characteristic test is lack of visual intuition. At the same time, students lack practical hands-on experience, and can not design, debug and analyze a large number of highly applicable contents in the course, and can not well connect theoretical knowledge with practical application. In order to improve students' practical ability, the application of Flash and Matlab is added to the course to make the learning content more vivid and intuitive, which is more conducive to students' understanding of knowledge and improving their interest. At the same time, students' ability to program with Matlab and other software is cultivated. In the course of classroom teaching, practical cases are often used to let students experience how to use the knowledge they have learned.

2.1.5 Transfer Learning.

Transfer learning refers to the process in which students memorize, understand and master the knowledge they have learned, and then actively apply the knowledge to solve new problems. On the basis of appropriate course content, moderate difficulty and abundant practical cases, application transfer learning can help students better understand, master and consolidate what they have learned. There are two main types of transfer learning: supervised transfer learning and unsupervised transfer learning.

- Supervised transfer learning

Supervised transfer learning mainly refers to the learning under the supervision of teachers in class, that is, after learning, understanding and mastering the knowledge, the process of using the learned content to complete the tasks assigned by teachers in different situations in class, so as to further consolidate the learned knowledge.

- Unsupervised transfer learning

Unsupervised transfer learning mainly refers to the learning without teacher's supervision, including two aspects, one is to use the teacher's problem analysis method to analyze the problem and complete the homework after class; The second is the use of the teacher's ideas to learn new knowledge and the process of integration.

2.1.6 Assessment Method.

The traditional assessment method is relatively simple, taking the final exam as the final assessment score, and lacks the comprehensive consideration of the development of students' comprehensive quality. Therefore, the examination of students in various aspects is taken as the final assessment form. The final assessment score consists of the process assessment score and the final examination score.

- The process assessment consists of four parts. The students' self-study and classroom learning are reflected by the rain classroom test; the homework after class is composed of individual work and group cooperation projects, which need to be submitted to the rain class; flipped classroom consists of two parts: teacher evaluation and group evaluation; the experimental situation and results are submitted to the rain class by the students and corrected by the teacher
- The final examination score consists of two parts: the theoretical examination score and the experimental examination score.

2.2 Curriculum Reform Implementation Process

In the "Signal and System" course, the representative chapter content is selected to implement teaching reform. In the time domain analysis of continuous system and discrete system (Table 1), the properties of Fourier transform and Laplace transform (Table 2) are similar in content, and the overall learning and analysis ideas are similar. Therefore, after comparing and analyzing the course content, the teacher can mainly explain the time domain analysis of continuous system and the properties of Fourier

transform. For the discrete system time domain analysis and the properties of Laplace transform, transfer learning can be used to realize students' autonomous learning.

Table 1. Comparison of time domain content analysis between continuous system and discrete system

Time domain analysis of continuous system	Time domain analysis of discrete system
differential equation	Difference equation
Classical solution	Classical solution
0-, 0+	—————
Zero input response	Zero input response
Zero state response	Zero state response
Impulse response	Impulse response
step response	step response
Time domain decomposition of continuous signal	Time domain decomposition of discrete signal
Definition of a convolution integral	Definition of convolution sum
Graphic method	Graphic method
—————	Convolution without carry multiplication
Properties of convolution integrals	Properties of convolution sums

Table 2. Comparison of properties of Fourier transform and Laplace transform

Fourier transform	laplace transform
Linear property	Linear property
Timeshifting property	Timeshifting property
Symmetrical property	—————
Frequency shifting property	Complex frequency shifting property
Scaling transform property	Scaling transform property
Convolution property	Scaling transform property
Differentiation and integration in time domain	Differentiation and integration in time domain
Differentiation and integration in frequency domain	Differentiation and integration in S domain
Parseval's relation for aperiodic signals	—————
Parity	—————
—————	Initial and final values

The specific process is as follows (as shown in Figure 1).

- The teacher releases preview content for students to study by themselves through the rain class, and releases pre-class quizzes to check the students' preview status;
- The teacher explained the time domain analysis of the continuous system(the nature of Fourier transform) through rain class, PPT, Flash and Matlab, and used Rain class to release in-class quizzes to test students' classroom learning.
- Groups of students analyze discrete systems(the properties of the Laplace transform) on their own by finding relevant resources and using the analytical ideas they have learned.

- Learning is carried out in the form of flipped classroom. Students explain what they have learned after class and raise their own questions, and teachers answer the questions and supplement the imperfections.
- Students and teachers graded the performance of each group separately through the rain class;
- The teacher uploaded the homework after class through the rain class, and the students completed and submitted it on time.
- Students implement applications of different nature through Matlab and submit experimental results through rain class.

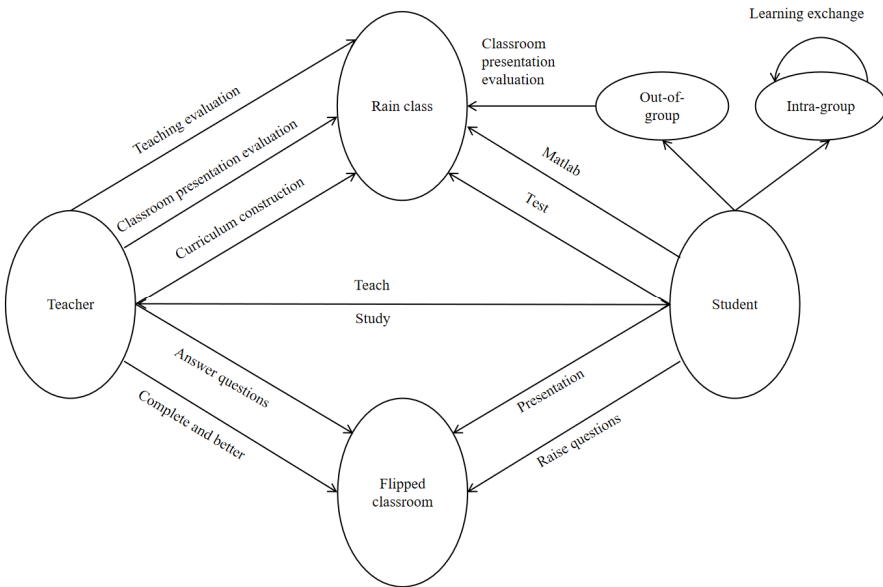


Fig. 1. Teaching implementation process

3 Curriculum Reform Effect

Through the curriculum reform, all aspects have achieved good results.

- Highlight the principal role of students: By adopting flipped classroom and other forms, the main body of the class is changed from the teacher to the student, which exercises the independent thinking ability and logical expression ability of the students, improves the class participation and learning initiative of the students, and stimulates the students' interest in learning.
- Improved practical ability: By adding practical cases, Flash and the application of Matlab into the course, the learning content is more vivid and intuitive, which is more conducive to students' understanding, mastering and applying knowledge.
- Improved teaching quality: Through the optimization of teaching content, teaching methods, reasonable use of teaching resources, network resources, students' learn-

ing quality and teachers' teaching quality, students' self-learning ability and self-control ability have been improved, and students' comprehensive quality has been enhanced.

- Updated teaching concept: By introducing modern teaching methods and teaching concepts into classroom teaching, teachers pay more attention to the comprehensive development of students' innovation, initiative and practicality, which updates the traditional teaching concept of teachers and is more conducive to training talents to adapt to the innovative society.
- Enhanced collective consciousness: Through group learning and division of work within the group can enhance students' sense of responsibility, collective consciousness, solidarity and collective sense of honor.

4 Conclusion

Curriculum reform is an important process for the development of universities. By updating the teaching content, the class time arrangement is more reasonable and the course content is more practical. By joining the flipped classroom, the main role of students is more prominent, and the initiative is improved. Through the use of rain classroom, Matlab and other means, students' learning effect has been improved. Through updating the assessment method, the limitation of single assessment is broken through and the assessment is more comprehensive.

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