

Teaching Method Reform Exploration of Professional Basic Theory Courses in Universities—Taking “Signals and Systems” as an Example

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Abstract. This paper explores the teaching method reform of professional basic theory courses in universities. A series of reforms have been carried out on basic theoretical courses, such as information and communication professional basic theory course “Signals and Systems”. The reform contents include making full use of multi-media teaching methods, visualizing teaching contents, rationally arranging classes, paying attention to the repetition of lectures, cultivating application abilities, and focusing on the practical application of the theory. Finally, the continuity of curriculums should be emphasized. After implementation of teaching method reform, teachers’ teaching quality in class was improved, students’ interest in learning was strong, teacher-student interaction was promoted and better teaching effects were achieved. This teaching mode can be promoted in the same professional basic theory courses.

Introduction

Professional basic theory courses such as “Signals and Systems”, which usually belongs to the basic course of electronic information and communication engineering, plays an essential role in undergraduate teaching. Some core concepts and methods of the course appear in a wide range of fields. The ideas and methods related to these concepts do an important part in many scientific and technical fields, such as communications, aviation and aerospace, circuit design, acoustics, seismology, bioengineering, energy generation and distribution systems, chemical process control and voice processing, etc. In fact, as engineers face new challenges that require analysis or synthesis of complex processes, the potential and practical application of “Signals and Systems” analysis methods has been expanding. In addition, this course is not only a basic course in theoretical teaching, but also can be the most useful course for engineering students in the university education.

This course contains basic principles and methods of time-domain, frequency-domain, Z-domain analysis of signals and systems, as well as the similar properties of Fourier transforms, Laplace transforms, Z transforms, and the derivation of these properties. Although the physical properties of the signals and systems appearing in different fields are very different, they all have two basic points in common: the signal as one or several independent variable function contains information about the nature of certain phenomena. And the system always generates additional signals in response to a given signal, or produces certain desired characteristics ^[1]. Therefore, it is very significant for students to study such professional basic theory courses. In addition to the understanding of students, the teachers’ teaching methods are particularly important. The following points explored about teaching method reforms of professional basic theory courses.

Making Full Use of Multimedia Teaching Methods and Visualizing Teaching Contents

“Signals and Systems” is a course which focuses on theories and concepts. The characteristics of traditional teaching methods are mostly manuscripts, lectures, and later evolved into a multimedia PPT. It is easier for students to acquire knowledge and information owing to adjustment of teaching methods. Students are no longer limited to view the blackboard and listen to teachers’ explanation. For those students who do not understand the content, they can copy the PPT themselves and review

the lesson once again. It is obvious that multimedia teaching method has advanced students' knowledge acquisition to some extent. Meanwhile, multimedia network resources integrate domestic and foreign counterparts and reflect the new disciplinary development at any moment. It provides a large number of learning references and related network link addresses, etc. And it offers a platform for students to communicate well. However, with the popularization of the Internet, this mode has become a popular teaching method. Students are gradually becoming immune to such teaching style. Because they can copy the contents of their own classes, many students do not concentrate on listening and speaking, they learn by themselves difficultly and thus give up learning. The effect is not as good as the traditional manuscripts and board-writing methods. Therefore, some teachers hurriedly adopt traditional teaching mode and start to write board books with chalks. However, such methods are inefficient and time-consuming. It is still not a kind of teaching way that can be promoted.

In the current era, we should make full use of multimedia to teach and enrich the teaching contents. The electronic teaching plan should be made more vivid and rich, not just moving textbooks or books on the blackboard. We should use an easy-to-understand electronic lesson schedules, take full use of blackboards and chalks to solve difficult problems. In the classroom, we should make full use of heuristic teaching styles and combine with visually intuitive multimedia demonstration, and thus it could guide students to think methods, theories and applications independently. This established the application and innovation awareness so that students can appreciate the basic concepts profoundly, then students can see, think and even do it. Learning scientific thinking mode has laid a solid foundation for proactive and scientific learning^[2]. From the classroom teaching effects feedback, the students' learning enthusiasm has been evidently raised. Students have a self-study platform, so that they can earnestly listen to lectures and use the copied electronic lesson plans to review knowledge points after class. After this mode was adopted, the teachers' teaching quality in classes was significantly enhanced, and students' mastery of knowledge was more solid. For instance, the content of the classic textbook of the United States, "Signals and Systems", was written by Professor Oppenheimer of Massachusetts Institute of Technology. In the ninth chapter Laplace transformation, the contents of electronic lesson plan can be more specific, combined with the formula, and draw the corresponding zero, pole and its ROC in a different way. It has deepened students' understanding of the curriculum with the visualized combination of figures and shapes.

Through the teaching content, multimedia visualization presentation and practice, the students have made further progress in their studies. It overcomes the problems that students feel difficult to understand, difficult to learn, and difficult to use. In conclusion, students have enhanced their knowledge and comprehensive capabilities^[2].

Reasonable Arrangement of Classes and Focusing on the Repeatability of the Lecture

At present, the class hour compression is common in major universities, and thus the course content can be interpreted only once. However, for basic theoretic subject such as "Signals and Systems", beginners often cannot understand the contents of classes and forget easily, thus a lesson is often learned very little. In addition, the teaching content is more while the class hour is less. This curriculum uses more mathematical knowledge, and students are required to learn a large number of mathematics. It faces a contradiction that there is a requirement relating to the more contents and fewer classes problem^[3]. Consequently, teachers will expedite course explanation, and the next time, they will simply review contents of the last time. This mode is similar to the word memory method of some institutions. This style can allow students repeatedly to learn and to memory the content of the course with a few hours. There is no doubt that students' learning efficiency can be raised.

For instance, the three major transformations in the Signals and Systems course: Fourier transforms, Laplace transforms, and Z transforms have many similar properties and mathematical derivation^[4]. As the old saying goes, after singing thousands of songs and thus we can have an insight into sounds, and after watching thousands of swords and thus we can know the weapons well. Consequently, when teachers are teaching the three major transformations, they can perform

analogical studies, arrange their time reasonably, repeat the teaching content of the previous lesson at the beginning of each lesson, and pay attention to the analogy, thus repeat the review of the students' learning content. Moreover, Carrying out an investigation, strengthening teacher-student exchanges so as to help each other and reusing learning resources, the above mentioned measures benefit teachers as well as students. Students changed from "requiring me to study" to "I want to learn" ^[5]. According to students' feedback, students have benefited more from this instruction. This teaching mode can be extended to similar professional basic theory courses ^[6].

Cultivating Application Capabilities and Focusing on Practical Applications Involving the Theory

The "Signals and Systems" course contains a wide range of topics and its applications are very extensive. There are a variety of ways in which teachers can teach. The most boring thing is that the teachers are very skilled in textbook and they simply read in the class. Practical teaching is the key to educational method reform of signals and systems. Before this style is proposed, the common practice teaching mode is that teachers explain related theoretical knowledge and then students carry out the experiment class according to the experimental class arrangement. This method is relatively mechanical and rigid. It is only allows students to mechanically repeat the contents of the class. There is no effect on cultivating students' application ability. The course contents are generally abstract, the theorems, axioms, deductions, and relating formulas are relatively numerous in the meantime. For example, the fourth chapter's formulas are close to one hundred. Although doing tests and assignments can partly increase students' theoretical knowledge appreciation, the essential operation and training become very indispensable for cultivating students' application ability ^{[6][7]}. The application ability is not just a simple experiment course, but it needs to attach importance to the practical application involved in the theory.

We all have experienced that we can achieve higher scores by reviewing day and night after completing a course. But the problem has arisen. We can very skillfully deduce the nature of major transformations and the role of various systems ^[8-10]. However, we are not clear that what is the engineering application involved in the knowledge point. Accordingly, this requires instructors to clearly explain the practical applications involved in the theory while imparting knowledge, so that students can clearly understand what role this theoretical knowledge plays in everyday life and what kind of practicality it has. At the same time, the professors could properly add some cases and questions in their teaching process. Students' imagination can be stimulated through visualized cases and problems. The innovative consciousness and innovative thinking can be expanded ^[11]. As a result, students can better understand and apply the practical applications involved in learning the curriculum. At the same time, their application ability has been cultivated.

Focusing on the Continuity of the Curriculum

We know that "Signals and Systems" plays the vital role in the teaching process. Firstly, it is based on advanced mathematics, linear algebra, complex functions, and circuit analysis courses. Meanwhile, it is also a follow-up course for digital signal processing and communication principle, digital image processing, speech signal processing, and automatic control principles ^{[12][13]}. It is a compulsory course for engineering students.

We should think highly of the continuity of the curriculum. It is emphasized the physical significance and engineering application of key knowledge points after the teaching mode reform ^[14]. So we compare the relevant contents and guide students to infer others. For example, when teachers explained the convolution integrals involved in the linear time-invariant system in Chapter 2, they can analyze the process of modulation, let students understand the application of convolution integrals, and thus lay the groundwork for subsequent communication principles. After explaining the continuous system's zero-input response and zero-state response, the above content should be linked with the discrete system. When the professor is teaching Fourier transform properties, they can

associate it with follow-on Laplace transforms and Z transforms ^[15]. Adding this part can make the knowledge point more vivid and allow students to more deeply comprehend the theoretical knowledge application that they have learned. According to this educational structure, students can further understand the curriculum's consistency ^[16].

Summary

To sum up, this paper proposes four teaching method reform explorations of Signals and Systems. This type of instruction is suitable for professional basic theory courses in universities. In addition, this mode can be popularized in similar courses. In the signals and systems teaching process, we should actively introduce advanced teaching tools and teaching modes into this curriculum and constantly innovating teaching models. Indeed, faced with the challenges of new problems, new technologies and new opportunities, the teaching method reform has been continuously evolving and developing. New problems may arise in the course of teaching method reform. How to enhance educational methods and quality more effectively requires constant reform, development and innovation.

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