



# The exploration of the multi-mode teaching method of the new specialized basic course of engineering which deeply integrates "Internet +"

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**Abstract.** At present, the requirements for students' critical thinking, problem-solving ability, and active innovation ability have been higher. To this end, according to the connotation of new engineering, this paper deeply integrates and uses "Internet +" and other multi-elements to deeply explore, design and practice the multi-mode teaching methods. In addition to building a complete teaching system of professional basic courses, the author also designed a capacity structure model, put forward a novel participatory evaluation model, and set up a set of experimental teaching methods based on the close combination of Internet + platform and offline physical operation. The multi-mode teaching scheme is applied to the actual teaching, and has achieved good teaching results.

**Keywords:** Multi-mode teaching; New engineering; Specialized basic course; Internet +; Novel Participatory Evaluation.

## 1 Introduction

In the 21st century, there has been a great change in the requirements of higher education for students, which is reflected in the cultivation of critical thinking and problem-solving, effective communication, innovation, collaboration and other abilities. At the same time, the requirements for teachers have also changed - they are required to integrate relevant technologies in teaching, use new methods to implement teaching, communicate teaching content with relevant teachers in a timely manner, and make full use of multiple elements such as the Internet + to enrich teaching resources.

China has put forward the "China's Education Modernization 2035 strategy" - improving the ability of first-class talent training and innovation. Over the years, many domestic colleges and universities have built a number of national quality courses, national video resources open courses, etc., which can be regarded as the excellent teaching reform results of the broad "Internet + teaching".

Reference [1] put forward some countermeasures under the background of new engineering construction based on "Internet +". Reference [2] proposed a new teaching method combining online and offline teaching based on the "Internet+". The authors of reference [3] and [4] explored the method of introducing ideological and political

elements into certain curriculum teaching with the help of "Internet +". Fu et al. [5] designed a multimedia type based system, using the combination of Internet data mining technology and recommendation algorithm to carry out Chinese teaching. Dong et al. [6] noticed that the rapid development of "Internet +" has greatly promoted the reform of higher education. Wang et al. [7] introduced the teaching innovation and practice from several dimensions. Reference [8] introduced a teaching method in which teachers made full use of a new media English platform based on "Internet +" to conduct English classes. It is worth mentioning that many scholars from several countries such as Czech Republic, Hungary, Slovakia, and Austria have collaborated to research and develop the European Nuclear Test Education Platform (ENEPP), an online platform based on the concept of "Internet Plus" [9].

According to the connotation of new engineering, this project will deeply integrate and use "Internet +" and other multi-elements to deeply explore, design and practice the multi-mode teaching method (including both theoretical teaching and experimental teaching) of professional basic courses.

## 2 Multi-mode Teaching Method of the New Specialized Basic Course of Engineering Which Deeply Integrates "Internet +"

### 2.1 Construction of the Whole Teaching System of Specialized Basic Courses

Aiming at the research of this project, a cross-curriculum teaching team for professional basic courses has been set up, and a set of overall teaching system has been constructed. The preliminary ideas are as follows:

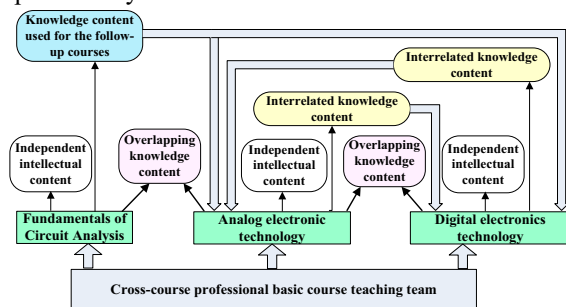


Fig. 1. Schematic diagram of building an overall teaching system

For students majoring in electronic information of new engineering, the learning contents of the three basic courses of digital circuit, analog circuit and circuit analysis are both significantly different and have certain connections. In the construction of the teaching system shown in Fig. 1, it can be found that it is very necessary to sort out what are the independent knowledge points, overlapping knowledge points and interrelated knowledge points in the teaching of the three courses.

## **2.2 Exploration of New Methods of Multi-mode Teaching**

### **A Hybrid Model of Online and Offline**

In view of the reality of class time compression, on the basis of the whole teaching system, reasonable arrangement of offline and online teaching content and methods. Online content is ideally a further extension or expansion of the classroom content. Taking the digital circuit course as an example, students have mastered the method of "using 74161 chip to design a counter" in the class, then they can continue to learn online about "how to use 74160 chip to design a counter". Teachers can make full use of resources such as MOOCs and Love courses, and provide platforms for student practice and interaction between teachers and students with the help of Rain class and WeChat groups.

### **A Model Combining Teaching and Discussion**

Discussion is an effective way to implement heuristic teaching. This project intends to design the content and implementation of the discussion skillfully, which can be divided into narration, debate, etc., and scoring basis, so as to truly inspire students to actively participate in the discussion and further promote them to thoroughly grasp the relevant content.

### **Combination of Competition and Collaboration**

The combination mode of competition and cooperation is designed and implemented through discussion and completion of Project-based Learning (PBL). For many project-based tasks, such as "Design M counting module", students can be encouraged to design freely, and make full use of the "Internet + system" and experimental box verification function, then discuss and share with everyone. In this way, there is both competition and collaboration among students, which can not only greatly enhance students' interest in learning, but also stimulate a sense of achievement, and then cultivate independent learning and innovation awareness and practical ability.

## **2.3 Design of Innovative Experimental Teaching Mode That Deeply Integrates "Internet +"**

The traditional experimental teaching method has many shortcomings, such as rigid time, small space for students to play freely, and relatively fixed experimental medium. To this end, after a semester of teaching, the author of this paper tried an innovative teaching mode that is a deep integration of "Internet + system", experimental box, all-weather server. Confirmatory experiments for familiarizing equipment are carried out in laboratory chambers; The comprehensive and designed experiments were carried out using the "Internet +" system; Innovative and expansive experiments are done through PBL projects. In particular, it should be noted that for comprehensive and designed experimental problems, in order to deeply mobilize students' flexible thinking and problem-solving ability, the authors of this paper innovatively proposed for the first time that the values of several key parameters in the experimental circuit should be

determined by students' own student numbers through certain mathematical calculations.

### 3 Construction of Student Participation Evaluation and Feedback Subsystem

In order to make the above multi-mode teaching method produce the best possible teaching effect, the authors propose a novel participatory evaluation NPE (Novel Participatory Evaluation) mechanism. The mechanism is let students themselves to evaluate whether some aspect of specific knowledge learning of their own specific ability cultivation and exercise have a direct support and nourishing effect.

In view of the knowledge and skills that electronic information engineering students need to master, the authors have specially designed and constructed the ability model shown in Fig. 2. Obtaining the model means completing the first phase of NPE work. It can be seen that this ability structure model consists of three parts: ability domains, ability levels, and the space for ability development. Of these, the ability levels are further divided into two aspects: knowledge and skills. The space for ability development mainly shows what kind of work a student can engage in after mastering the corresponding ability.

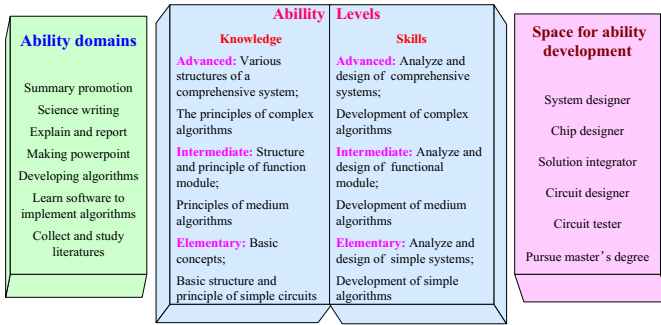


Fig. 2. The ability model structure for undergraduate students majoring in engineering

The remaining two stages of the NPE are: Students evaluate whether the corresponding course (or the specific content of a certain course) can indeed nourish and support the components of the corresponding ability model structure; and evaluate the specific teaching content and the teaching method adopted by teachers to obtain the ability training and the practical effect of training.

Taking "Digital circuit" as an example, we have carried out the experiment of this multi-mode teaching and NPE on undergraduates of a certain grade, and the results are shown in Table 1.

**Table 1.** Specific results of statistical tables based on NPE

	Chapter content	Specific content		Average of the student's ability level	Distribution of students' actual ability level (percentage)					
					1	2	3	4	5	
Teaching content	Fundamentals of logic algebra	Basic concepts and theories	elementary	4.970	0.0	0.0	0.0	7.0	97.0	
		Formulae simplification	intermediate	4.710	0.0	0.0	0.0	29.0	71.0	
		Carnot diagram simplification method	advanced	4.322	0.0	0.0	10.0	47.8	42.2	
	Gate circuit	Basic knowledge	elementary	4.929	0.0	0.0	0.0	7.1	92.9	
		Structure and principle of various gate circuits	intermediate	4.100	0.0	3.9	21.0	36.3	38.8	
		Knowledge of external characteristics	intermediate	3.872	0.0	3.2	33.1	37.0	26.7	
		Interconnection of heterogeneous gate circuits	advanced	4.646	0.0	0.0	4.4	26.6	69.0	
	Combinatorial logic circuit	Analytical method	elementary	4.480	0.0	0.0	9.0	34.0	57.0	
		Structure of various modules and the use of representative chips	intermediate	4.789	0.0	0.0	3.2	14.7	82.1	
		Design method	advanced	4.756	0.0	0.0	3.8	20.4	75.8	
	Sequential logic circuit	Structure and working principle of various triggers	elementary	4.310	0.0	0.0	14.6	39.8	45.6	
		Analytical method	elementary	4.595	0.0	1.9	3.9	27.0	67.2	
		Structure of various modules and the use of representative chips	intermediate	4.348	0.0	0.0	15.1	35.0	49.9	
		Design method	advanced	4.183	0.0	2.2	18.8	37.5	41.5	
	Generation and shaping of pulse waveform	Structure and working principle of several basic circuits	elementary	3.926	0.0	4.8	29.0	35.0	31.2	
		Structure and principle of 555	intermediate	4.369	0.0	0.0	10.4	42.3	47.3	
		Use 555 to realize all kinds of circuits	advanced	3.978	0.0	5.5	23.3	39.1	32.1	
	A/D and D/A	Structure and principle of ADC	intermediate	3.893	0.0	6.1	31.0	30.4	32.5	
		Structure and principle of DAC	intermediate	4.442	0.0	0.0	9.4	37.0	53.6	
	Teaching process and method		Count the number of fields given by students		List the role played in the level of support capacity	Summarize the students' feelings about the role played by the level of supporting ability				
Case teaching				Elementary Intermediate Advanced	Enhance the understanding and mastery of the basic principles and corresponding methods					
Answer questions				Elementary Intermediate	Solved problems and doubts in time					
Student seminar		① Collect and study literature ② Learning software			Elementary Intermediate Advanced	Lots of ideas come up; has greatly promoted the improvement of learning effect				
Cooperative learning		③ Development algorithm ④ Make PPT ⑤ Explain and report ⑥ Summarize and promote			Intermediate Advanced	Greatly exercised a variety of abilities; Through the cooperation to complete the tasks based on CT elements, the combination of theory and practice is well realized, and the textbook knowledge is expanded				

## 4 Conclusions

This paper proposed a multi-mode teaching method for basic courses of new engineering electronic information majors. This multi-mode makes full use of “Internet +” and other elements, and effectively carries out the teaching of basic courses through the

combination of online and offline, the combination of competition and collaboration, and the combination of teaching and discussion. Moreover, in order to effectively improve the learning effect of students, a set of ability model structure is constructed, and a new participatory evaluation mechanism is introduced on this basis. The results of research and teaching experiment show that the scientific and reasonable application of multi-mode teaching based on "Internet +" and NPE mechanism can effectively exercise students in all aspects of their ability fields and significantly promote the improvement of students' ability level.

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