The Research on the Comprehensive Ability Evaluation Model of RF Electronic Technology Experiment Course

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ABSTRACT

In view of the wide range of majors involved in the electronics courses and the fact that there are many students in our college, the relevant practical training links have lacked a scientific and reasonable comprehensive ability assessment and evaluation model. This article applies the cloud model theory to the practice training assessment and evaluation of electrical courses. We aim to establish a set of fair, reasonable, scientific and standardized comprehensive ability assessment and evaluation model, which can accurately reflect the effect of practical teaching, comprehensively evaluate the level of knowledge, and ability and quality of students. Meanwhile, it help to cultivate innovative talents, promoting the comprehensive advancement of practical teaching reform.

Keywords: RF electronic technology, cloud model, cloud generator, Comprehensive ability evaluation mode

1. INTRODUCTION

Experimental teaching of RF electronic technology is the key to the teaching of electronic engineering and information engineering in military colleges and universities. It is an important link to cultivate students' innovative spirit and practical ability. RF electronic technology training occupies a large proportion in the college, which involves a wide range of majors and faces many students. If can establish an objective, fair, fair and reasonable evaluation mechanism for integrated evaluation of the student practice result, it is not only beneficial to guide students to correctly treat the practice teaching, can promote the student in the teaching practice in the process of implementation of the initiative, enthusiasm, can greatly stimulate the student understanding of it's in the center position of practice teaching, and but also good for teachers to improve the practice teaching methods and means, in order to better improve the quality of teaching. Therefore, practical ability assessment is an important means to evaluate and motivate students' learning, and its rationality and fairness are especially important. In view of the difficulty of RF electronic technology course, many practical projects involved and strong comprehensiveness, it is an urgent problem to construct a set of scientific and reasonable comprehensive ability evaluation model.

2. EVALUATE THE PROBLEMS EXISTING IN THE EXPERIMENTAL COURSES OF RF ELECTRONIC TECHNOLOGY

According to many years of teaching experience found that the RF electronic technology experimental course grades are generally based on the usual experimental reports and experimental operations to determine. This evaluation model has the following problems: (1) Method is single and lack of multilevel and diversity. All the students do the same experiment according to the steps, and the evaluation result can be obtained after the experiment, which is not conducive to the improvement of teaching quality.(2)The content of the project lacks comprehensiveness and research, which is not conducive to cultivating students' application ability and innovation consciousness.(3)The lack of scientific and reasonable evaluation index system of experimental teaching makes the evaluation of experimental teaching lack of integrity in terms of items, methods and scores, which is not conducive to the integration of RF electronic technology experimental teaching content and the establishment of the curriculum system. (4) The biggest difference between practical assessment and theoretical assessment is its process management, while the existing assessment of experimental results are mostly derived from experimental results and experimental reports, unable to evaluate the experimental process, which is not conducive to the development of students' strengths and personality. [1]

From the perspective of comprehensive ability evaluation, it is urgent to introduce an evaluation system that can scientifically and rationally evaluate students' comprehensive practical ability.

3. GENERAL IDEA OF COMPREHENSIVE ABILITY EVALUATION OF RF ELECTRONIC TECHNOLOGY EXPERIMENT COURSE

3.1. Thinking of Comprehensive Ability Evaluation

According to the specific environment of the laboratory and the actual situation of students, we divided the evaluation of RF electronic technology experimental course into three modules, namely, experimental process, experimental operation and analysis of experimental data, as shown in Figure1.
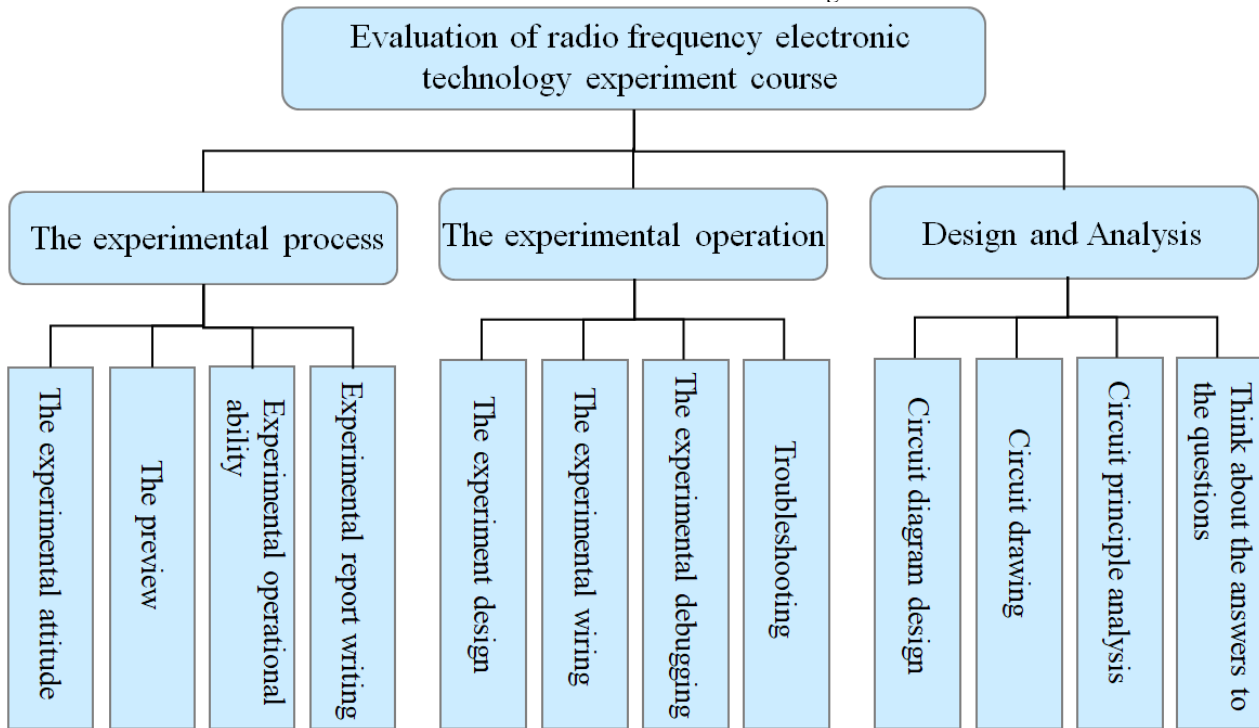

Figure 1 Evaluation module distribution diagram of RF electronic technology experiment course

The evaluation of the experimental process is mainly from the experimental attitude, experimental preview, experimental operational ability and the writing of experimental report and other aspects to investigate the experimental effect of students at ordinary times, this part as the usual scores; Experimental operation is mainly from the experimental design, experimental wiring, experimental debugging, troubleshooting and other aspects of independent evaluation of experimental operation; Design and analysis mainly from the circuit diagram design, circuit diagram drawing, circuit principle analysis and thinking question solution and other aspects of independent analysis ability, this part as an experimental theoretical evaluation.

3.2. Detailed Rules of Comprehensive Ability Experiment Evaluation

The grades will be evaluated comprehensively in the way of "peacetime (60%) + examination (40%)"[2], According to the characteristics of radio frequency electronic technology experiment course and the teaching experience and teaching experience of the members of the research group for many years, a more perfect and detailed rules for the evaluation of students' achievements are summarized, striving to evaluate each student's achievements fairly, reasonably and accurately. The evaluation table of students' experimental results is shown in Table 1.[3]

Table 1 Rules for the evaluation of RF electronics experimental courses

Peacetime Score 60						Examination Score 40		
Evaluation indicators		excellent	good	normal	poor	Evaluation indicators		score
Preview situation 10%	The preview report is complete	3	2	1	0	Experimental theory 35%	Basic operation methods and basic concepts	4
	Answer questions in class	3	2	1	0			
Experimental operation 20%	Proficiency leve	7	6	5	4			
	Analyze problem solving ability	5	4	3	2		Basic principle and usage of the instrument	10
Finish the task 30%	Basic experimental content	14	11	9	6			
	Improve sexual selection of content	4	3	2	1			
Experimental report 40%	Finish writing on time	3	2	1	0	Experimental operation 65%	Operation ability	15
	The data are clear and the calculations accurate	15	13	11	9		Basic experimental content	5
	Complete the extended thinking questions	4	3	2	1		Improve experimental content	6

The students are assessed according to the experimental preparation in each experiment course, the classroom questioning, the experimental discipline, the accuracy of practical operation, the credibility of the experimental results, the quality of the experimental report and other aspects, and are recorded. At the end of the semester and the final assessment results are combined to obtain the total results of the experimental class. It can be seen that each statistic is very complicated, and there is a certain ambiguity and uncertainty, which really increases the workload of teachers' assessment.

The final assessment of the experimental course adopts the forms of random questions and group questions for practical operation and theoretical assessment, and examines students' independent operation ability, experimental phenomenon analysis and interpretation ability and experimental summary ability. Here the practical operation is carried out in the laboratory, and the experimental theory adopts the online form, and the online evaluation results are automatically generated online, which can reduce the heavy workload of teachers, and at the same time give students a fair and just assessment results.

4. APPLICATION OF CLOUD MODEL FOR EVALUATION OF EXPERIMENTAL COURSES ON RF ELECTRONICS TECHNOLOGY

The cloud model, a concept proposed by Li Deyi, an academician of the Chinese Academy of Engineering, in 1995, is a model that deals with the uncertainty transformation between qualitative concepts and quantitative descriptions, that is, it can transform these fuzzy concepts into specific data and present them visually in cloud images. Cloud model has been successfully applied to natural language processing, data mining, decision analysis, intelligent control, image processing and other fields due to its advantages in dealing with ambiguity and randomness.[4]

The performance evaluation of RF electronic technology experiment is a multi-level and multi-objective evaluation problem, which involves a lot of contents. Many evaluation elements are fuzzy and random, so it is difficult to divide them into "neither here nor there" simply, and it is difficult to describe them accurately by traditional mathematical models. Cloud model is exactly the qualitative and quantitative exchange model proposed on the basis of traditional fuzzy mathematics and probability statistics [5]. It organically combines fuzziness and randomness, and

realizes the conversion between qualitative linguistic values and quantitative values. Therefore, we apply the cloud model theory to the evaluation of RF electronic technology experimental results, and carry out scientific statistics and evaluation of the most difficult and troublesome results in ordinary times.

4.1. Cloud Model

Cloud has three numerical characteristics, namely Expected(Ex), Entropy(En), and Super Entropy (He).Figure 2 is the digital feature diagram of cloud [6]. Where, the horizontal axis represents the range of uncertainty measurement of a certain concept, and the vertical axis represents the membership degree. The Expectation(Ex) is the expectation of the spatial distribution of cloud droplets in the field of argument, the central value of the field, and the point which can best represent this qualitative concept. Entropy(En) represents the uncertainty and fuzziness of cloud droplet distribution. Super Entropy (He), the entropy of entropy. The higher the super entropy, the greater the uncertainty of the model and the greater the thickness of the cloud. These three numerical features combine fuzziness and randomness, vividly display the shape of clouds, and complete the mutual mapping between qualitative and quantitative [6].
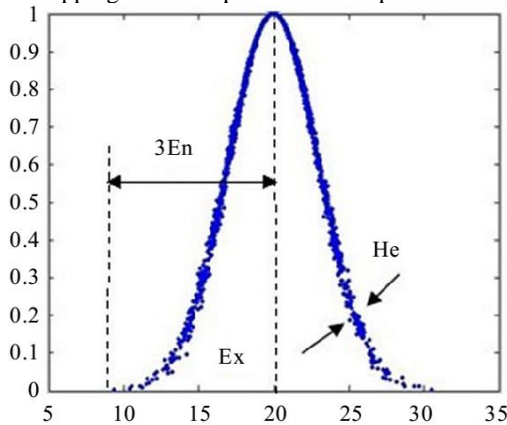

Figure 2 The digital characteristics of the cloud

Normal clouds are the most important cloud model. The theory of normal cloud is based on the universality of normal distribution and the universality of normal membership function. It expects the curve to be a normal curve, and defines $y = \exp[-(x-Ex)^2/2(En)^2]$ as the expected curve of the normal cloud(X,Y)[7].

The generating algorithm of normal cloud is:
- Generate a normal random number x_i with expected value Ex and standard deviation En;
- Generate a normal random number En'_i with En as the expected value and He as the standard deviation;
- Calculate $y_i = \exp[-(x_i-Ex)^2/2(En'_i)^2]$, and

make(x_i,y_i) as a cloud droplet, which is a concrete realization of the language value represented by the cloud in quantity, where x_i is the corresponding value of qualitative concept in the field of argument, y_i is a measure of the degree of belonging to the language value;
- Repeat the above steps until the desired number of cloud droplets is produced.[8]

The model is used to implement the cloud generator. Cloud generator is a cloud-generating algorithm that can be implemented by modularized software or hardened hardware. According to its function, there are positive and negative cloud generators. Positive cloud generator is a forward and direct process, which is a mapping from qualitative concept to its quantitative representation. Cloud droplets are generated based on the digital characteristics of the cloud, where each ach cloud droplet is a concrete implementation of this concept. This is done by inputting the digital characteristics of three clouds (Ex,En,He) and the number of cloud droplets to be generated, and outputting the coordinates of each cloud droplet in the number domain, as well as the certainty that each cloud droplet represents the concept. The principle is shown in Figure 2. Negative cloud generator is the reverse process of forward cloud generator. It is a conversion model of quantitative values to qualitative concepts, which can transform a certain amount of accurate data into qualitative concepts represented by digital features (Ex,En,He). Specifically, input the cloud droplet that conforms to a specific distribution, and output the cloud model as the corresponding three digital characteristics (Ex,En,He). The principle is shown in Figure 4.[8]
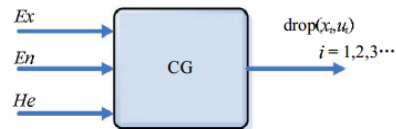

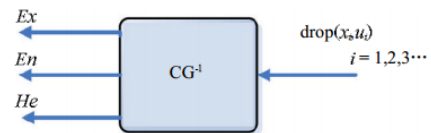**Figure 3** One-dimensional positive cloud generator

Figure 4 One-dimensional negative cloud generator

4.2. Cloud Model Method for Evaluation of Experimental Courses in RF Electronics Technology

Experiment result evaluation of the radio frequency electronic technology courses many factors with the fuzziness and randomness of problem, we will cloud model theory is applied to the experiment result assessment, through the use of cloud generator implementation

experiment evaluation standard of qualitative and quantitative transformation, and the multi-factor comprehensive evaluation model of evaluation, gain the final evaluation results.

4.2.1. Determine the Weights of Evaluation Elements of the RF Electronic Technology Experimental Course

We divide the assessment rules in Table 1 into several first-level and second-level assessment elements according to the elements [9]. Here we record the peacetime assessment and the final assessment separately, especially the peacetime assessment elements are numerous, many elements are not quantitative, but fuzzy, the workload of evaluation record is very large. Such as in table 2 and table 3 have plenty of quantitative assessment elements, have a plenty of value in qualitative and fuzzy language to express a certain amount of scale, such as "experiments operation"

elements of assessment in evaluation standard in " content proficiency ", we use "excellent, good, better, normal, poor" language to describe some students in the experimental process, such as through its actual operation situation of the experiment and the coordination between the group members and situation to judge the students proficiency in the contents of the experiment. Therefore, the evaluation elements need to be quantified and transformed to transform fuzzy language into deterministic language.

During the experiment, the importance of evaluation factors is reflected by setting the weight value of evaluation factors. The weight values of evaluation factors in Table 2 and Table 3 are converted according to the evaluation rules in Table 1, in which Table 2 is the weight value of peacetime evaluation factors and Table 3 is the weight value of final evaluation factors.

Table 2 The weight of the elements of evaluation in the RF electronic technology lab course

Primary elements	Secondary elements	Evaluation standard					Weight W
Preview situation V1(0.1)	The preview report is complete V11(0.5)	very complete	complete	less integrity	normal	incomplete	0.50
	Answer questions in class V12(0.5)	excellent	good	better	normal	poor	0.50
Experimental operation V2(0.2)	Proficiency in contentV21(0.583)	very skilled	skilled	better	normal	unskilled	0.583
	Analyze problem solving abilityV22(0.417)	excellent	good	better	normal	poor	0.417
Finish the task V3(0.3)	Basic experimental content V31(0.778)	excellent	good	better	normal	poor	0.778
	Improve sexual selection of content V32(0.222)	excellent	good	better	normal	poor	0.222
Experimental report V4(0.4)	Finish writing on time V41(0.125)	excellent	good	better	normal	poor	0.125
	The data are clear and the calculations accurate V42(0.708)	very accurate	exact	better	normal	inaccuracy	0.708
	Complete the extended thinking questions V43(0.167)	excellent	good	better	normal	poor	0.167

Table 3 The weights of the elements assessed at the end of the RF electronic technology lab cours

Primary elements	Secondary elements	Evaluation standard					Weight W'
Experimental theory $V_1^{'}(0.35)$	Basic operation methods and basic concepts $V_{11}^{'}(0.285)$	90-100	80-90	70-80	60-70	< 60	0.285
	Basic principle and usage of the instrument $V_{12}^{'}(0.715)$	90-100	80-90	70-80	60-70	< 60	0.715
Experimental operation $V_2^{'}(0.65)$	Operational capability $V_{21}^{'}(0.577)$	90-100	80-90	70-80	60-70	< 60	0.577
	Basic experimental contents $V_{22}^{'}(0.192)$	90-100	80-90	70-80	60-70	< 60	0.192
	Improved experimental content $V_{23}^{'}(0.231)$	90-100	80-90	70-80	60-70	< 60	0.231

4.2.2. Qualitative and Quantitative Conversion of Evaluation Elements and Comprehensive Evaluation Results

According to the rules of comprehensive ability evaluation of rf electronic technology experiment course, all levels of evaluation factors are established, and the evaluation criteria of each factor are respectively described by cloud model. This step is the key, which is related to whether the evaluation results are objective and reasonable. Here, specific cloud models are given for each evaluation element, such as the evaluation standard of "content proficiency" of the element in "experimental operation". The qualitative concept is expressed as follows in the cloud of sub-range: Excellent=D((95,10/3,0.05),good=D(85,10/3,0.05),better= D(75,10/3,0.05),normal=D(65,10/3,0.05),poor=D (55,5/3,0.05),the other elements are similar, and then the cloud generator is used to realize the qualitative and quantitative transformation of the evaluation elements and obtain the quantitative values of each evaluation element. According to the weight of the obtained evaluation factors and the quantitative value of each evaluation factor of students, the multi-factor comprehensive evaluation model $V_i = \sum_{j=1}^{n} V_{ij} W_{ij}$ is used to analyze and process, and the evaluation results of primary factors are obtained, where V_{ij} is the quantized value of the jth sub-element of the ith element in the first-level element, and W_{ij} is the weight of the jth sub-element of the ith element in the first-level element. In the same way, the multi-factor comprehensive

evaluation model $V = \sum_{j=1}^{n} V_i W_i$ is used to obtain the final evaluation result of students' experiment [10], where Vi is the quantized value of the ith element in the first-level element, while Wi is the weight of the ith element in the first-level element.

5. SUMMARY

The scientific and normal comprehensive ability evaluation model can not only reflect the effect of experimental teaching accurately, but also evaluate the knowledge level, ability level and quality of students comprehensively. Meanwhile, it is conducive to cultivating innovative talents, which plays an important role in promoting the comprehensive reform of experimental teaching. Currently, there exists the wide range of specialties involved in the RF electronic technology courses of our college with the fuzziness and randomness of relevant experimental evaluation elements. In view of this, cloud model and multi-factor comprehensive evaluation model of tools are adopted to realize RF electronic technology experiment examination evaluation, which can more accurately the assessment of the specific conditions of the students' comprehensive ability completely. It is also the radio frequency electronic technology experiment course of practical training the comprehensive ability to build a scientific and reasonable evaluation model. The application of this model has a good reference value for the training and evaluation of other disciplines.

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