

# Teaching Reform and Practice of Embedded System Structure under OBE Background

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**Abstract.** According to the OBE concept, in the order of defining outcomes, designing courses, organizing teaching, implementing teaching, and evaluating learning achievements, the teaching reform is implemented for the students of Grade 2020 in Computer Science and Technology of Changchun Institute of Engineering. The whole teaching activity is carried out around the course objectives, emphasizing the principle of process supervision. Through the analysis of the degree of achievement of the course objectives, we will continue to track and improve the teaching effect in education and teaching to promote the quality of professional training.

**Keywords:** OBE;teaching reform;embedded system;SPOC

## 1 Preface

Outcome Based Education (OBE) is an education and certification concept that adapts to the connotative development law and high-quality requirements of higher education under the new situation. Its application will help China's higher education transform from "input oriented" to "output oriented", so as to establish a talent training system in colleges and universities that takes students' learning results as the logical starting point [1-2]. Combining the OBE concept with the actual situation of the computer science and technology major of Changchun Institute of Engineering, the idea of "reverse design and forward construction" is adopted for Grade 2020 "embedded system structure" course of computer major to build the OBE target system, carry out the reform of course objectives, course teaching content and course assessment, improve students' engineering practice ability, and cultivate students' innovation awareness [3-4].

## 2 Define outcome

The first step of OBE concept at the practical level is to "define outcome". The professional training program breaks down the 12 general standards of graduation requirements into 33 graduation requirements index points. Among them, the first graduation requirement includes indicator point which named 1.4. The third graduation requirement includes indicator point which named 3.2. The fourth graduation requirement includes indicator point which named 4.1. According to the above three indicator points, according to the above three indicators, three

course objectives are set. The weights of the corresponding indicator points supported by the three course objectives are 0.25, 0.3 and 0.2 respectively.

### 3 Design Course

The course is the foothold of reverse design and the starting point of forward construction [5]. According to the requirements of the talent training program and outline, the teaching content is split and integrated around the course objectives [6-7]. The basic knowledge system of the embedded system with MCU as the core of this course is divided into four modules, namely the minimum system, basic output, embedded communication and common application modules, as shown in Fig.1. On the basis that students master the core knowledge of "minimum system" principle, they will gradually master the interface level application of embedded systems, laying the foundation for subsequent courses.

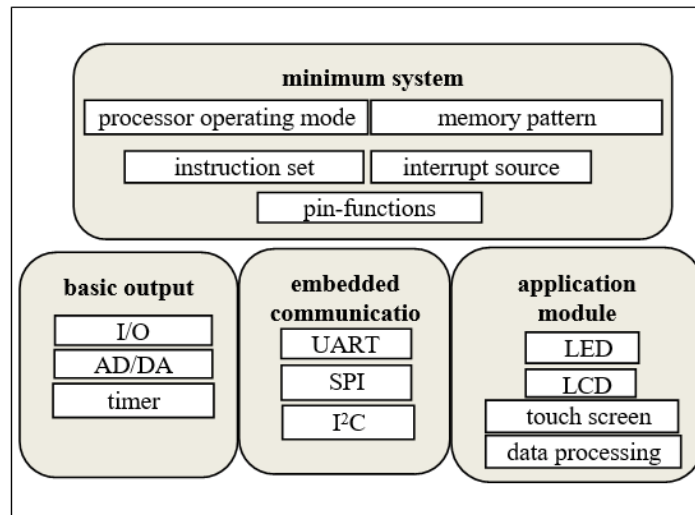


Fig. 1. Decomposition module diagram of embedded system knowledge system with MCU as the core

### 4 Teaching implementation

According to the process of OBE concept, teaching is organized before the implementation of teaching, which refers to the supporting system serving teaching before the beginning of teaching. The outcome oriented teaching should be guaranteed to be carried out smoothly according to the principle of result orientation. The next step is to implement teaching in the form of flipped classroom.

The teaching of "embedded system structure" through semi flipped classroom can mobilize students' enthusiasm for learning and maximize the teaching quality and efficiency of embedded courses [8-9]. The decomposed and refined knowledge points are mapped to specific curriculum objectives. Teachers record each knowledge point into a 10 minute video, and carry out semi flipped teaching in offline classes. Teachers should systematically summarize knowledge in the

classroom, so that students can learn from point to point and expand their knowledge to achieve teaching objectives[10].

The online resources of this course include 10 task point chapters, 16 non task point chapters, 14 videos, 162 minutes of video, 17 documents, 15 other materials, and 204 questions in the question bank.

## 5 Evaluate earning outcomes

The last step of OBE concept is to evaluate the learning achievements. Based on the principle of emphasizing process supervision, the assessment is integrated into each stage of the students' learning process, and the final comprehensive weight is used to get the overall score. The final grade of the semester consists of four parts: homework, stage test, experiment and final exam.

### 5.1 Algorithm of achievement degree of curriculum objectives and indicator points

#### 1. Build model

If the course is set as C, the relationship between relevant indicator point A and assessment link B is:

$C = \{c_1, c_2, \dots, c_n\}$ ,  $c_i$  is the  $i$ th course objective,  $i=1, 2, \dots, n$ ; for a certain indicator point, the supporting course set is  $\{C_1, C_2, \dots, C_n\}$ ;

$A = \{a_1, a_2, \dots, a_m\}$ ,  $a_j$  is the  $j$ th indicator point related to course C.

$B = \{b_1, b_2, \dots, b_p\}$ ,  $b_k$  is the  $k$ th assessment related to course C,  $k=1, 2, \dots, p$

$W_{ci}$  is the weight value of curriculum objective  $c_i$ ,  $i=1, 2, \dots, n$ ,  $0 < W_{ci}$

$W_{aj}$  is the weight value assigned by the course to the indicator point  $a_j$ ,  $j=1, 2, \dots, m$ ;  $0 < W_{aj} \leq 1$ , note that an indicator point  $a_j$  will be supported by multiple courses, that is, one course only supports part of the corresponding  $a_j$ .

$W_{bk}$  is the weight value of course assessment  $b_k$ ,  $k=1, 2, \dots, p$ ,  $\sum_{k=1}^p W_{bk} = 1$ ,  $0 < W_{bk} \leq 1$ .  $C_k$  is based on the percentage system.

A. Construct the relationship matrix  $W_{CA}$  between the overall course objective and the related indicator point A.

$$W_{CA} = \begin{matrix} & a_1 & a_2 \cdots & a_i \cdots & a_m \\ \begin{matrix} c_1 \\ c_2 \\ \vdots \\ c_i \\ \vdots \\ c_n \end{matrix} & \begin{bmatrix} W_{11} & W_{12} & W_{1i} & W_{1m} \\ W_{21} & W_{22} & W_{2i} & W_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ W_{i1} & W_{i2} & W_{ii} & W_{im} \\ \vdots & \vdots & \vdots & \vdots \\ W_{n1} & W_{n2} & W_{ni} & W_{nm} \end{bmatrix} \end{matrix} \quad (1)$$

There are some description of relevant symbols:  $W_{ij} \geq 0$ ,  $W_{ij}$  is the weight value of  $c_i$  assigned (or supported)  $a_j$ ,  $W_{ci} = \sum_{j=1}^m W_{ij} > 0$ ,  $W_{aj} = \sum_{i=1}^n W_{ij} > 0$ .

$W_{CA}$  is generally a "sparse" matrix, that is, one course objective corresponds to one indicator point.

B. Construct the curriculum objectives and assessment score table  $M_{CB}$

**Table 1.** Course Objectives and Assessment Score Table

	b1...	bk...	bp	Weighted summation
c1...	m11...	m1k...	m1p	$m_{c1}^*$
ci...	mi1...	mik...	qip	$m_{ci}^*$
cn	mn1...	mkn...	qip	$m_{cn}^*$
summation	100	100	100	
Weighted summation	$100 \cdot W_{b1}$	$100 \cdot W_{bk}$	$100 \cdot W_{bp}$	100

There are correlation equations.

- $m_{ik}$  is the score assigned by  $b_k$  to the course objective  $c_i$  in the course assessment;  $i=1,2,\dots,n$ ;  $k=1,2,\dots,p$ ;
- The full score of  $b_k$  is 100.
- $M_{ci}$  is the sum of the scores allocated by assessment  $b_1, b_2, \dots, b_p$  for the course objective which named  $c_i$ .
- $m_{ci}^*$  is the weighted sum of the scores assigned by the assessment phases  $b_1, b_2, \dots, b_p$ , that is, the full score of  $c_i$ .

2. Calculate the degree of achievement of course objectives

Assume that the average score of the sub goal  $c_i$  of the course in the assessment is  $m'_{ik}$ ,  $i=1, 2, \dots, n$ ;  $k=1, 2, \dots, p$ ; then the weighted total of  $c_i$  is equation (2).

$$m'_{ci} = \sum_{k=1}^p m'_{ik} \times W_{bk} \quad (2)$$

Then the degree of achieving the overall course objective is equation (3).

$$d_c = \sum_{i=1}^n m_{ci}^* \% \quad (3)$$

The achievement degree of each course objective is equation (4).

$$d_{ci} = \frac{m'_{ci}}{m_{ci}^*} \quad (4)$$

3. Calculate the achievement degree of the indicator points corresponding to the course objectives

Actual value of indicator point supported by course objective assessment result is expressed as equation (5).

$$W'_{c_{a_i}} = \sum_{j=1}^n (d_{c_i} \times W_{c_i} \times \frac{W_{ii}}{W_{c_i}}) = \sum_{i=1}^n (d_{c_i} \times W_{ii}) \quad (5)$$

## 5.2 Analysis of achievement degree for Grade 2020

According to the model:

A={1.4,3.2,4.1},B={ homework, stage test, experiment , final exam },Construct the relation matrix according to equation(1):

$$W_{CA} = \begin{matrix} & \begin{matrix} 1.4 & 3.2 & 4.1 \end{matrix} \\ \begin{matrix} c1 \\ c2 \\ c3 \end{matrix} & \begin{bmatrix} 0.25 & 0 & 0 \\ 0 & 0.3 & 0 \\ 0 & 0 & 0.2 \end{bmatrix} \end{matrix}$$

Table 2 shows the target assessment scores.

**Table 2.** Target assessment scores

	homework 10%	stage 10%	test	experiment 20%	final exam 60%	Weighted summation
c1	60	60	0	50	42	
c2	40	30	50	30	35	
c1	0	10	50	20	23	
summation	100	100	100	100		
Weighted summation	10	10	20	60	100	

The actual assessment scores of Grade 2020 are shown in Table 3.

**Table 3.** The actual assessment scores of Grade 2020

	homework 10%	stage 10%	test	experiment 20%	final exam 60%	Weighted summation
c1	48	38	0	43	34.4	
c2	34	20	42	20	25.8	
c1	0	7	35	11	14.3	
summation	82	65	77	74		
Weighted summation	8.2	6.5	15.4	44.4	74.5	

According to equation (3), the degree of achievement of the overall goal of the course is  $74.5/100=0.745$

According to equation (4), the degree of achievement of each course objective is as follows:

- $d_{c_1} = 34.3/42 = 0.82$
- $d_{c_2} = 25.8/35 = 0.74$
- $d_{c_3} = 14.3/23 = 0.62$

According to equation (5), the actual value of the weight of the first indicator point supported by the course is:

$$W_{Ca1}=0.25\times 0.82+0\times 0.74+0\times 0.62=0.205$$

The actual value of the weight of the second indicator point supported by the course is:

$$W_{Ca2}=0\times 0.82+0.3\times 0.74+0\times 0.62=0.222$$

The actual value of the weight of the third indicator point supported by the course is:

$$W_{Ca3}=0\times 0.82+0\times 0.74+0.2\times 0.62=0.14$$

It can be seen that the achievement of the third curriculum objective is relatively low, and the continuous improvement measures should be carried out for the third curriculum objective. The specific measures are to pay attention to the operation demonstration and theoretical explanation in the experimental, enrich and improve online course teaching resources, strengthen online and offline communication and Q&A.

## 6 Conclusion

According to the OBE concept, this paper reforms and practices the teaching of the "Embedded System Structure" course of Grade 2020 in the computer science and technology specialty of our school. Through this practice teaching, students' engineering practice ability has been enhanced in a range. By analyzing the degree of achievement of course objectives, we can continuously track and improve the teaching effect in education and teaching to promote the quality of professional training. In the process of teaching reform, there are also some problems that need to be deeply considered, which need to be constantly considered and improved in the future teaching practice.

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