Teaching Reform Design of Applied Advanced Undergraduate Course Based on Fogg Model

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Abstract

Aiming at the analysis of the teaching status of the core professional courses in applied undergraduate, taking the advanced course "Distributed System Application Practice" as an example, a Fogg model-based teaching design scheme for application-oriented undergraduate software engineering students was proposed. combined with the learning situation of application-oriented undergraduate students, complex engineering problems were designed to construct a system of students' comprehensive thinking ability, analysis ability, solution decision-making ability, and tool application ability, the purpose is to design a set of suitable for applied undergraduate software engineering practice teaching systems, to improve students' ability on solving complex problems in software engineering, to increasing the students' professional identity, laying the foundation for the students to achieve high levels of employment. According to the reconstructed teaching content, the corresponding weight coefficient and the weighted average method is used to calculate the achievement degree of the examination results. The data on students' achievement degrees provides important support for the continuous teaching reform of the teaching team.

Keywords: *Applied Undergraduate, Fogg Model, Complex Engineering Problem, Weighted Averages*

1 INTRODUCTION

Distributed system practice course belongs to the core curriculum group of the major. Due to the strong theoretical and practical depth of the course itself, the establishment of the course can help to implement the cultivation of students' complex system-problem ability and innovation ability. Therefore, it is necessary to explore and reconstruct the teaching mode, teaching structure, teaching evaluation, and other aspects of this course. Based on the improvement of education quality, this paper starts with the teaching status quo of the "Distributed System Application Practice" course for application-oriented undergraduate software engineering majors. Combined with the classroom feedback of students, by applying the FBM (Fogg Behavior Model) Model of Professor B.J.Fogg [4], who is a psychology expert from Stanford University, we can reconstruct the teaching content, and construct spiraling learning scenes. According to the educational objective classification method of the Bloom-Anderson Model [6], by reconstructing the establishment of the model and the teaching mode and teaching method, we can reach the target of abilities of students' comprehensive system thinking, analysis, solution decision-making, and tool application, which can provide strong support for the cultivation of innovative application-oriented talents with the ability to solve complex system problems.

2 CURRICULUM BACKGROUND

Distributed system application practice course is an elective course of professional core software engineering major. The content of this course involves the basic concept of a distributed system, basic principles and basic methods, research scope covers the data structure and algorithm, network communication, database principle, object-oriented program design, software modeling technology curriculum knowledge. Due to the course referred many the system of practice and theory, the curriculum itself has the characteristics of a high order. Through the teaching of this course, students can have a systematic understanding of the basic concepts, architecture, design principles, and methods of a distributed system. This course joined the need of High-level talents in companies, which provided a foundation for long-term development of students.

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3 THEORETICAL BACKGROUND

According to the Model FBM (Fogg Behavior Model) proposed by Professor B.J.Fogg, who is a psychologist from Stanford University, to understand human behavior, the elements of Behavior production are divided into motivation, ability, and triggering mechanism. According to the situation analysis of applied undergraduate students, when students have strong motivation, their acting ability is low, while when their behavior ability has high requirements, their learning motivation is low. This paper will reconstruct the teaching content and teaching mode which centers on the balance point of these three core mechanisms.

In the practical application of the distributed system, memory, understanding, and application are the primary stages of curriculum requirements, while analysis, evaluation, and creation are the advanced abilities. In this paper, according to the Bloom-Anderson cognitive ability model, the teaching evaluation will construct the corresponding six-level evaluation standard and reorganize the teaching structure and content, which can shape students' ability to analyze, evaluate, and innovate, based on the implementation of memory, understanding and application ability.

The formation of complex engineering problems' analysis and processing ability is similar to the generation of enterprise products. Referring to the complete process of the Juran quality Spiral model [3], the spiral can only be realized through continuous practice summary and principle analysis, based on the practical theory of distributed systems. This paper will construct a spiraling process chain from the aspects of course content construction, teaching implementation methods, and course assessment.

Through analyzing the teaching feedback of the course over the years, the research team members found that it was difficult for students to have spontaneous and active learning behaviors in the course teaching process. To solve the above problems, the teaching reform implementation strategy of a distributed system is based on the Fogg behavior model, and the curriculum implementation process is constructed based on the Juran quality spiral curve as the standard, and the ultimate goal is to achieve the upper competence of Bloom-Anderson model.

4 CURRENT SITUATION OF COURSE TEACHING

4.1.Current situation of teaching implementation

In the whole professional talent training program, general education and basic science hours accounted for a large proportion, and students learned more professional theoretical knowledge in the first semester, with insufficient support for the practical system. Students have insufficient knowledge of how to apply theoretical knowledge to engineering practice. Lack of global perspective and thinking mode when encountering complex system problems. According to the analysis of the FBM model, this course has high requirements on students' comprehensive ability and quality, and students' low learning motivation and learning promotion factors will greatly affect the occurrence of students' active learning behavior.

Teaching in the process of the teaching team to change the status quo of the teaching strategies based on unitary time and TBL (team learning) teaching model [5], at a fixed time (15 minutes) as the teaching time unit, the completion of teaching students in groups for the unit to carry out the discussion and practice, the teaching evaluation link to training report and project completed module as the main basis, Such teaching strategy adjustment has stimulated students' learning motivation to a certain extent. However, due to insufficient practice accumulation and high requirements on students' comprehensive ability and quality, the probability of students' active learning behavior in the follow-up teaching process is very small.

4.2 Current Situation of Student Ability

Many application-oriented colleges and universities have similar student source structures. When implementing teaching plans, students present the following two phenomena: (1) Students with rich coding practice only pay attention to coding practice, ignoring the analysis and summary of theoretical problems behind the practice; (2) Students who learn more theoretical systems have a lower mastery of practical tools and technical language. As a result, during the implementation of the teaching plan, students have difficulty in locating modern tools and complex environmental problems, only complete the technology application practice according to the teaching requirements, and pay insufficient attention to the analysis and summary of systematic problems and the analysis of the principle of technology application. According to the principle of the FDM model, the phenomenon is analyzed. (1) The reason is that the assessment indicators of the course do not pay attention to the achievement of the upper three levels of Bloom-Anderson's six-level educational goals; meanwhile, students have certain behavioral abilities but the low motivation for self-learning; (2) the reason is that students have the low behavioral ability and it is difficult to complete the course. It has a certain learning motivation, but the trigger point of the course teaching mode and teaching content is not enough for students, leading to the initiative of students into learning is not high.

5 RECONSTRUCTION OF CURRICULUM TEACHING SYSTEM

5.1.Reconstruction of teaching content

The redesign of teaching content is not only an important link in the construction of the Julan quality spiral curve but also the initial stage. The reconstruction of teaching content takes the actual learning situation, progress, and teaching feasibility as the preconditions, and takes the three factors of the mat in the FBM model as the theoretical basis to promote the occurrence of students' learning behavior, to achieve bloom Anderson cognitive ability model. The teaching content will be reconstructed from the following aspects: First, the teaching content of the complex system will be disassembled into several teaching theme modules, and the order of teaching themes will be adjusted according to the degree of difficulty. Different themes show a spiral increasing relationship, to solve the problem of low behavior ability of some students at the early stage of teaching; Secondly, the selected teaching cases should be attractive to students. In addition to the selected cases, the Alibaba middleware performance Challenge was introduced to enhance students' interest in the course content to achieve a positive influence of the course content on students' behavior motivation. Finally, the scale of teaching cases should be moderate and the system can run independently, and the complexity should be gradually increased according to the idea of the spiral model. so that students can gradually accumulate their sense of gain from practice through the whole process of teaching. so that multiple triggers of autonomous learning behaviors can be generated in the whole teaching process. According to the above teaching ideas, the teaching content is adjusted as shown in Table 1.

Table 1: Design of practical teaching content of the distributed system

Lecture topics	Level of Motivation	Capacity requirements
Weather service publishing subsystem	High	Easy
Train ticket buying subsystem	High	Easy
Commodity inventory management subsystem	Moderate	Moderate
Design of practical teaching content of the distributed system	Low	Hard

5.2.Reconstruction of teaching methods

The reconstruction of classroom teaching methods is an important guarantee to achieve the teaching objectives of distributed system practice courses. In the design of the teaching design system, the teaching team proposed an improved spiral quality model based on the Bloom-Anderson cognitive ability model, which iterated the teaching structure from teaching methods, quality control, professional knowledge, practical teaching, and other aspects to improve the complex engineering ability. This teaching method design is based on the flipped course teaching model as the means, with the theory of practice guidance before class, theory verification in-class practice, practice after class in-depth theory as the teaching ideas, based on the modular and modular teaching units from the pre-class, class, class three different links to carry out the teaching design respectively. The implementation of teaching methods requires the delivery of practice tasks before class. Some modules are selected to record practice operation videos and send them to students for pre-class practice. This part provides support for solving students' understanding, memory, and application ability, and collects common problems in practice in real-time. The teaching process of teaching theory in class is used to introduce the system demand scenario, construct the solution to meet the demand, and evaluate the quality of the completed practice module. This part provides support for improving the analysis and evaluation ability of students and urges them to complete the thinking transformation process from low order to high order. In the teaching practice section, students are organized to discuss or share ideas of problem-solving in groups. After class, the experimental report of this teaching content is handed out and students are asked to fill in the problem summary and principle analysis of this practice to make the teaching link form a closed loop. The whole teaching link follows the upward trajectory of the quality spiral curve. Gradually build students' ability of unit module function, algorithm, and distributed system design and analysis. The specific teaching method design is shown in Figure 1 below.

5.3.Reconstruction of the curriculum evaluation system

To reconstruct the curriculum evaluation system according to juran's quality spiral model, it is necessary to refine the curriculum quality evaluation standard, ensure the organic combination of multi-dimensional and multi-angle evaluation, and reflect the applicability, accuracy, and effectiveness of evaluation. In the past, the evaluation system of distributed system application practice curriculum was relatively simple, often relying on experimental reports and system completion quality as the main criteria for evaluation. However, the cultivation of application-oriented undergraduate engineering talents based on the CONCEPT of OBE pays more attention to the quality control of the whole teaching process [7]. and evaluates students' participation in pre-class practice guidance, in-class theory verification practice, and after-class in-depth theory practice. Through many discussions, the teaching team redesigned the assessment of programming technology courses. The assessment plan of the original experimental report is changed to completion of practical functions (20%), system design (20%), problem summary (20%), principle analysis (20%), project defense (10%), and open case design (10%). See Table 2 for specific information. Among them, students must complete the open case analysis based on distributed train ticket purchasing system after finishing the theoretical teaching. Through the evaluation of open design cases, it is verified whether the students' learning results are consistent with the harvest in practical teaching. By constructing an evaluation system based on Bloom-Anderson ability cognitive model, the achievement degree of each teaching achievement is evaluated, and the evaluation and cognition system of students for this course is reconstructed through the reform of a multi-dimensional evaluation scheme. At the same time considering the degree of differentiation of examination assessment results can be divided into three gradients, the gradient to conclude the ability of memory in cognition model, basic understanding and application of target assessment result for qualified, the second gradient to achieve the target of analysis or evaluation appraisal result is good, the third gradient in addition to the above two grades: the ability to achieve, It can also produce a certain amount of creativity and get a grade of excellent.

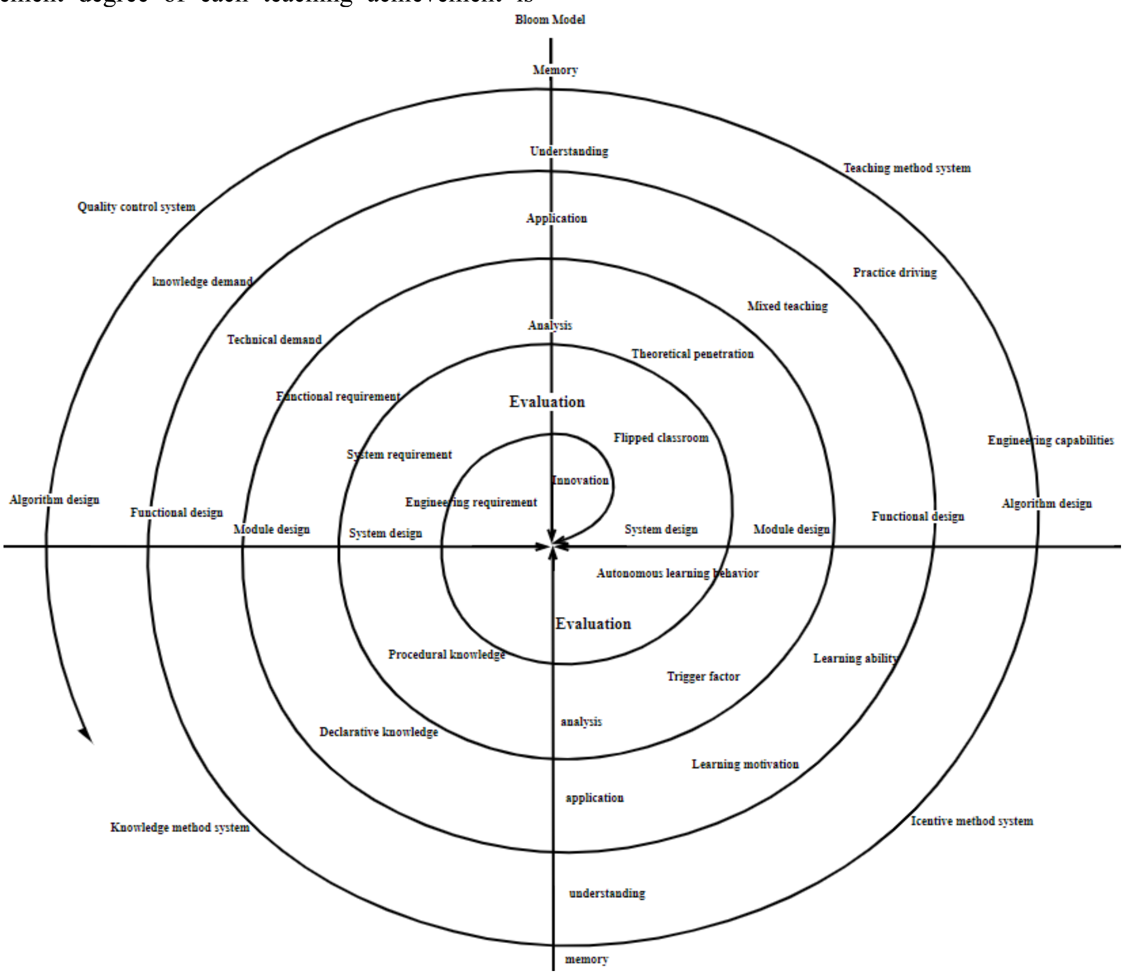

Figure1: Teaching method design

Table 2: Details of the assessment plan

The assessment content	proportion	The knowledge system	The target	Teaching stage
Functional completion	20%	Functional design	Memorizing, understanding, applying	Before class
The system design	20%	Module and system design	Understanding, applying	During class
Problem summary	20%	metacognitive	Analysis	During class
The principle of analysis	20%	Conceptual and procedural knowledge	Analysis	After class
Project defense	10%	Factual knowledge	evaluation	During class
Open case design	10%	innovation	innovation	After class

To evaluate the achievement of students' ability, the teaching team calculates each assessment content by introducing the fuzzy evaluation model in fuzzy mathematics. gives the proportion of students' assessment results by constructing a five-level assessment grade. The number of students corresponding to the assessment grade of an assessment content represents the total number of students participating in the assessment result grade. R ' matrix represents the result matrix of a certain appraisal content, and the R matrix represents the result matrix of all appraisal contents

To evaluate the achievement of students' abilities, the teaching team calculates the assessment contents by introducing the fuzzy evaluation model in fuzzy mathematics. The student assessment results are evaluated according to the five-level system, which the r_i represents the number of students at the assessment level of assessment content, and $\sum_{\mathrm{i}=1}^{n} r_i$ represents the total number of students participating in the assessment result level. R ' matrix represents the result matrix of a certain appraisal content, and the R matrix represents the result matrix of all appraisal contents [1].

$$\mathrm{R}' = \left(\frac{r_1}{\sum_{\mathrm{i}=1}^{n} r_i}, \frac{r_2}{\sum_{\mathrm{i}=1}^{n} r_i}, \cdots, \frac{r_{\mathrm{n}}}{\sum_{\mathrm{i}=1}^{n} r_i} \right) \quad (1)$$

$$\mathrm{R} = \begin{pmatrix} \mathrm{r}_{11} & r_{12} & \cdots & r_{1n} \\ \mathrm{r}_{21} & \mathrm{r}_{22} & \cdots & \mathrm{r}_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ \mathrm{r}_{m1} & r_{m2} & \cdots & r_{mn} \end{pmatrix} \quad (2)$$

According to the assessment content, the corresponding weight matrix $A = (a_1, a_2, \cdots, a_n)$ is designed, and the weighted average algorithm is used to fuzzy synthesize the result and weight matrix. Get the result vector matrix $B = (b_1, b_2, \cdots, b_n)$ of fuzzy operation [2].

$$\mathrm{B} = A \circ R = (a_1, a_2, \cdots, a_m)(r_{11} \;\cdots\; r_{mn}) = (b_1, b_2, \cdots, b_m) \quad (3)$$

$$b_j = \min\left(1, \sum_{i=1}^{m} a_i r_{ij}\right), j = 1, 2, \cdots, n \quad (4)$$

6 IMPLEMENTATION EFFECT OF CURRICULUM TEACHING REFORM

This course has carried out teaching work for 120 students of grade 2015 and 140 students of grade 2016. This course teaching reform has carried out teaching reform practice for 220 students of grade 2017 and 180 students of grade 2018 in a software engineering major. After the completion of the teaching work, a random questionnaire survey was conducted among the professional students. 98.91% of the students recognized the practical teaching reform plan, believing that the teaching method was appropriate and the teaching objective was reasonable, which could better solve the problem of their insufficient behavior ability and motivation in learning programming technology professional courses. Compared with the teaching status quo of students in 2015 and 2016, the learning participation of students in the grade with the implementation of teaching reform has significantly improved. At the same time, in terms of the statistics of graduation topic selection of professional students, more students choose graduation project topic selection comes from the technical practice scheme involved in the practical teaching of this course, and the corresponding employment rate of students in the graduation year has also significantly improved.

According to the course assessment results of 2017 and 2018 professional students, the assessment results of two teaching classes were selected, which the results were analyzed by using the fuzzy evaluation matrix. The highest weight value of grade 17 was 0.311, and the highest weight value of grade 18 was 0.318. The proportion of excellent and good grades is significantly higher than that of level 17 software engineering. The results of fuzzy matrix synthesis are shown in table 3 and 4.

Table 3: Comprehensive evaluation results of 2017's professional students

The assessment content	proportion	Number of excellent	Number of good	Number of medium	Number of qualified	Number of unqualified
Functional completion	20%	73	9	0	4	1
The system design	20%	16	49	13	3	6
Problem summary	20%	14	30	40	3	0
The principle of analysis	20%	6	20	36	13	12
Project defense	10%	15	30	20	11	11
Open case design	10%	8	25	32	11	11
Comprehensive evaluation results		0.277	0.311	0.264	0.078	0.069

Table 4: Comprehensive evaluation results of 2018's professional

The assessment content	proportion	Number of excellent	Number of good	Number of medium	Number of qualified	Number of unqualified
Functional completion	20%	43	17	10	0	3
The system design	20%	20	30	15	5	3
Problem summary	20%	20	23	15	12	3
The principle of analysis	20%	12	27	20	11	3
Project defense	10%	25	17	6	18	7
Open case design	10%	12	21	11	15	14
Comprehensive evaluation results		0.311	0.318	0.188	0.122	0.062

7 CONCLUSIONS

At present, many local colleges and universities are developing studies of the teaching innovation on the OBE concept. This trend will lead to the convergence of teaching methods and modes of some similar courses. Based on the current teaching situation of application-oriented undergraduate software engineering students, this paper puts forward a set of teaching reform ideas which are suitable for Application-oriented Undergraduates in local colleges and universities for the problems emerging in the professional courses of complex system types. The teaching mode reform proposed in this paper is supported by the FBM model and based on the learning situation of application-oriented undergraduates majoring in software engineering, with the method of guiding theory through practice, verifying practice, and deepening theory as the teaching thought, which is aiming at achieving the Bloom-Anderson model of cognitive ability. This paper constructs a feasible teaching scheme of advanced courses for application-oriented undergraduate majors. Systematic knowledge is adjusted according to the evolution process of software architecture, which can ensure that the difficulty of students' learning is in spiral mode. At the same time, the training goal of application-oriented undergraduate talents is highlighted, which can ensure that students can have a sense of innovation and the ability to solve complex system problems after graduation. In the subsequent teaching research, this teaching concept will be subsequently applied to other courses in the core professional curriculum group.

In the follow-up teaching reform, the strategy of helping students teach and learn will be adopted to further stimulate students' enthusiasm for active participation, which aims to solve the problem of teaching assistance efficiency between teachers and students. The subsequent teaching team will continue to adjust the allocation of teaching system, teaching methods and teaching hours.

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