The Design of Comprehensive Assessment System for Computer Major of SCM via CIPP-CDIO

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Abstract

In the background of the transformation of the application-oriented undergraduate majors, the concepts of CDIO engineering education and CIPP curriculum evaluation have been widely accepted by many domestic universities. Under the new educational concept and teaching mode, how to evaluate the students' progresses of the course effectively is a key problem, which needs a solution in the educational reform. In this paper, a comprehensive assessment system for the curriculum of single-chip-microcomputer is presented based on the fuzzy inference. Via four characteristics of the teaching process, the students' progresses are well evaluated by the assessment system, which will lay a solid foundation for the improvement of the quality of teaching.

Keywords: *Information science, education reform of computer major, assessment system, CDIO*

1 INTRODUCTION

With the development of productivity, the industrialization is the final result of the social division and production specialization. There is an increasingly growing demand of senior engineer and technical personnel with the higher professional quality. In the background, the engineering education certification, the plan for education and training outstanding engineers etc. are continually carried out by most of the application-oriented undergraduate majors of the domestic universities and thus achieve the educational transformation [2] [4] [5].

During the period of the transformation, the traditional educational concepts and teaching methods have not adapted to the new educational development. Now the concept of the engineering education, CDIO, has been widely accepted by domestic universities. CDIO is the English abbreviation of the four words conceive, design, implement and operate [1] [3]. The project development mode is the kernel of CDIO. Through the project development, the students can learn some rudimentary knowledge about conceiving, design, implement and operation. Meanwhile they can also obtain some engineering skills, practical experience and teamwork competency. With the change educational concept, the assessment methods of the traditional teaching cannot well adapt to the project teaching reform. Examination paper is hard to well assess the academic achievement of the project-based curriculum. Thus, how to ensure the teaching quality of project-based coursed is an urgent problem. CIPP, an evaluation method of education, gives so much importance to improve the quality of teaching and strengthen the monitoring of education. As CIPP is consistent with the concept of CDIO, the evaluation method is widely adopted by many domestic universities. The theory of CIPP is composed of four parts, which are context evaluation, input evaluation, process evaluation and product evaluation. the method focuses on monitoring and evaluating the teaching in the whole process. To improve the quality of teaching constantly, much information of teaching activities needs to be well gathered and comprehensively analyzed.

In the process of the project-based teaching, a great deal of process information and result data of teaching are applied to assess the quality of teaching. In most cases, these data are only analysed by the weighted average algorithm. But, for the concept of CDIO, the analytical results cannot objectively evaluate the quality of teaching. To carry out project-based teaching effectively, the design of the assessment system of teaching is the key problem. In this study, we will design a quality assessment system of teaching for the course of Single-Chip-Microcomputer (SCM) and a fuzzy inference will be used to fuse some teaching information in this system.

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2 THE QUALITY EVALUATION SYSTEM OF SCM COURSE BASED ON FUZZY INFERENCE

Fuzzy logic inference is one of the classic methods of the uncertainty reasoning. In the real world, the boundaries between some objects are clear, however, they are always being blurred and muddled for another objects. The human thinking is usually sketchy and the corresponding language is also qualitative. Thus, the concept of fuzzy is fitter for human thinking and decision.

In the project-based teaching of SCM, the ability assessments for students is very subjective. Teachers often make a subjective evaluation according to students' comprehensive performance in the process of completing the projects. In these teaching process, the quantitative assessment is difficult to distinguish the difference of the learning effects of students. Here, linguistic variables, such as excellent, good, medium, qualified etc., are more suitable for evaluate the learning effects of students, which is fitter for the concept of CDIO.

In the process of project-based teaching, there are many characteristics that are used to assess the effect of teaching. And these characteristics are rated as several levels by linguistic variables. Via these mentioned features, how to obtain a reasonable comprehensive achievement is a crucial problem in this study. Here, we will design a two-stage fuzzy inference system to solve the problem of multi-feature fusion.

Figure 1 is the fuzzy inference system of student's comprehensive achievement of SCM. The system is composed of the first stage fuzzy inference layer and the second stage fuzzy inference. The first layer consists of the fuzzy inference subsystem of the process assessment and the fuzzy inference subsystem of the product assessment. And the inputs of process assessment subsystem are the linguistic variable of learning attitude score and the linguistic variable of teamwork score. The other subsystem's inputs are the basic knowledge and pose-project grade. The second layer is the fusion subsystem, which is used to fuse the outputs of the first layer.

The fusion result, comprehensive achievement of SCM, is the output of the fuzzy inference system.

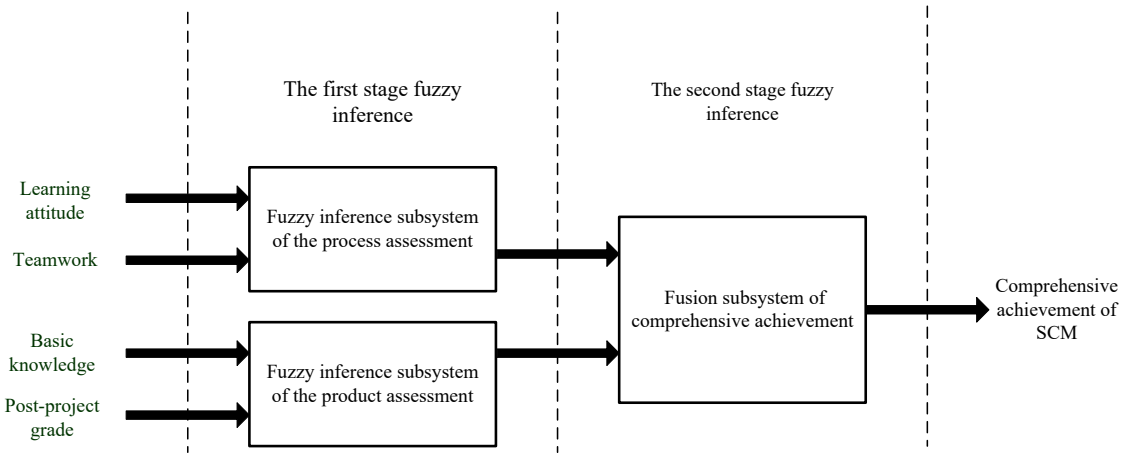


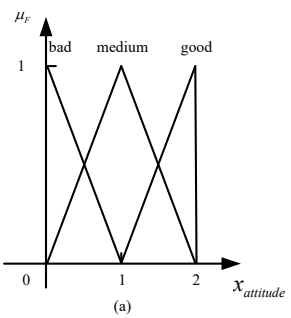
Figure 1: The fuzzy inference system of student's comprehensive achievement of SCM.

2.1 The First Stage Fuzzy Inference

Based on the concept of CIPP, the process assessment subsystem and product assessment subsystem will be designed in this subsection.

2.1.1 The Fuzzy Inference Subsystem of Process Assessment

In the process of project-based course, we choose the learning attitude and the teamwork as the input variables of the subsystem. The two features are graded by several linguistic variables in certain closed interval. In [0, 6], for example, a subjective score is used to assess the performance of the student in the course. And the higher mark shows that the student has better ability. In Figure 2, two linguistic variables attitude ($x_{attitude}$) and cooperation ($x_{cooperation}$) are divided into three grades and they are bad, medium and good respectively. Fuzzy set is set to triangle-shape of membership function. The universe of discourse is closed interval [0, 2]. Similarly, the design of the output ($o_{process}$) is the same as the input variables of this subsystem.



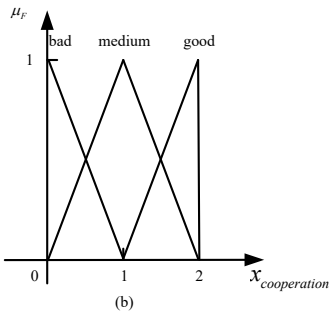


Figure 2: Two input membership functions of fuzzy inference subsystem of process assessment. (a) (b) are the attitude membership function and the cooperation membership function, respectively.

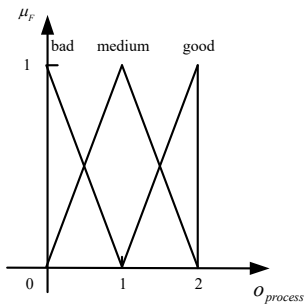


Figure 3: The output membership function of fuzzy inference subsystem of process assessment.

In the process of actual assessment, the higher score of learning attitude and cooperation means that students can obtain a higher achievement level in the assessment process. Based on the law of assessment, the rule of fuzzy inference of process assessment is shown in Table 1.

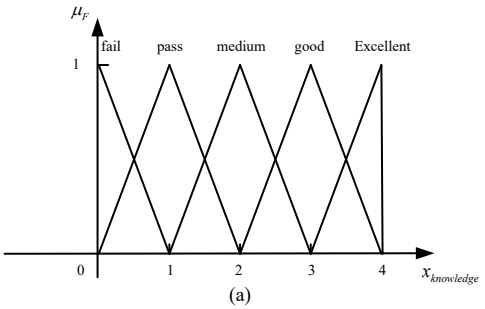
Table 1: The rule of fuzzy inference of process assessment.

$x_{attitude}$ / $x_{cooperation}$	bad	medium	good
bad	bad	bad	-
medium	bad	medium	good
good	-	good	good

2.1.2 The Fuzzy Inference Subsystem of Product Assessment

In the fuzzy inference subsystem of the product assessment, we will give the achievement level of product assessment via the situation of mastering basic knowledge and the post-project grade. Here, three variables, two inputs variables ($x_{nowledge}$ and $x_{project}$) and the output ($o_{product}$), are divided into five grades. Fuzzy set is set to triangle-shape of membership function. The universe of discourse is closed interval [0, 4].

The rule of fuzzy inference of product assessment is similar to the rule of process assessment. The score levels of two input variables have positive correlation with the comprehensive result of this part. And the rules of fuzzy inference are shown in Table 2.



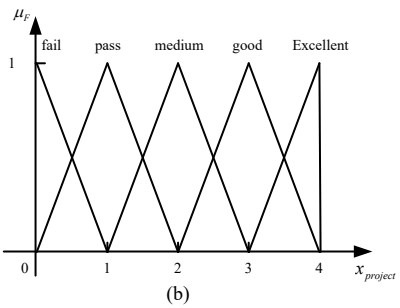


Figure 4: Two input membership functions of the fuzzy inference subsystem of the product assessment. (a) (b) are the membership function of the situation of mastering basic knowledge and the membership function of post-project grade, respectively.

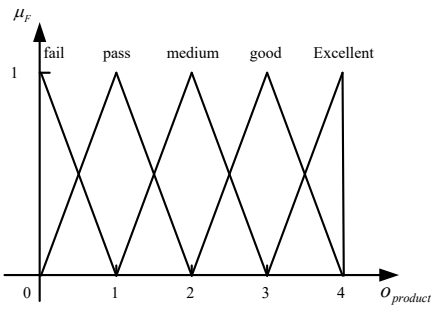


Figure 5: The output membership function of fuzzy inference subsystem of product assessment.

2.2 The Second Stage Fuzzy Inference

The function of the second stage fuzzy inference system is to fuse the outputs of the primary inference system, and thereby students will obtain the final total score of SMC. In Figure 1, the input variables of the second stage fuzzy inference are the output of product assessment subsystem ($o_{process}$) and the output of process assessment subsystem (o_{result}). As the input variables of the second stage fuzzy inference system, the number of the dividing grade and the universe of discourse are the

same as the design of the two outputs of first stage fuzzy inference system.

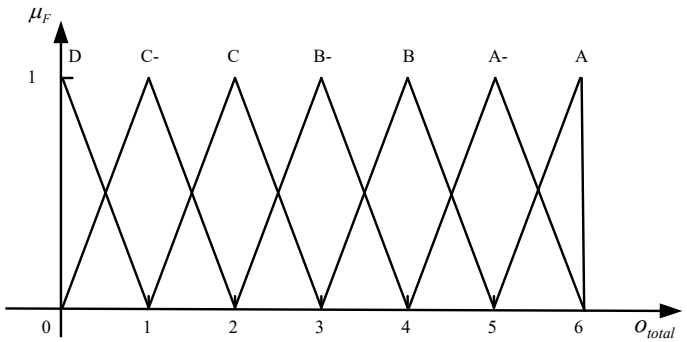


Figure 6: The output membership function of the second stage fuzzy inference system.

In Figure 6, the output of the fusion subsystem of comprehensive achievement is divided into seven grades, “A”, “A-”, “B”, “B-”, “C”, “C-”, “D”. Here, triangle-shape of membership function is adopted as the fuzzy set. The universe of discourse is closed interval [0, 6].

The comprehensive achievement of SCM has positive correlation with the results of the process score and the product score. That is to say, the higher score of the first stage fuzzy inference system means that students can obtain a higher comprehensive score of SCM. Based on the law, the rule of fuzzy inference of this stage is shown in Table 3.

In the study, the Mamdani-algorithm and the centroid method are used in the two stage fuzzy inference systems. In the two-level fuzzy inference system, the original data is abstracted and fused layer by layer.

Table 2: The rule of fuzzy inference of product assessment.

$x_{attitude}$ / $x_{cooperation}$	fail	pass	medium	good	excellent
fail	fail	fail	pass	-	-
pass	fail	pass	pass	medium	-
medium	pass	pass	medium	good	good
good	-	medium	good	good	excellent
excellent	-	-	good	excellent	excellent

Table 3: The rule of fuzzy inference of fusion subsystem of comprehensive achievement.

O_{result} / $O_{process}$	fail	pass	medium	good	excellent
bad	D	C-	C	B-	B
medium	C-	C	B-	B	A-
good	C	B-	B	A-	A

3 CONCLUSIONS

The transformation of the applied major in domestic universities has to be made. How to adequately carry out the concept of CDIO and the mode of CIPP is a problem that we must embrace and solve. Teaching and learning are an organic closed-loop system. The improvement of teaching methods is an iteratively optimized process. In the process, the effective assessment of teaching is an important technical problem, which determines whether the teaching methods can be continuously improved.

In this study, a comprehensive assessment system of student achievement of SCM is designed via the fuzzy inference. The assessment system is appropriate for the project-based teaching of applied undergraduate major, which can evaluate the students’ learning of SCM

effectively and provide the credible quality information of teaching for teachers.

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