Reusing Web Learning Portfolios by Case-Based Reasoning Technology to Scaffold Problem Solving

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Abstract
This study attempted to reuse the web learning portfolios to scaffold problem solving for activating students’ Zone of Proximal Development. First, we analyzed cases from students’ learning portfolios for getting case knowledge and student ability, and then used Case Based Reasoning technology for recommending cases to students. After students referred these cases, we adopted Data Mining technology and Issue-Based Information System to analyze the match model between students and cases. Finally, we constructed an online Case Based Learning System, which could retrieve and reuse the fitting cases to effectively scaffold problem solving on student learning process.

I. Introduction
Vygotsky’s theorem indicates experts’ supports can help students activate their Zone of Proximal Development (ZPD). Whether peer support can lift up student’s learning ability or not, there were some educators attempting to develop peer support [1] with a view to activating the ZPD [2] and extending student’s independent learning zone in a learning environment. Therefore, providing peer support in a student’s learning process will certainly activate the student’s ZPD. Some researchers [3] utilized past case experience to enhance learning, they all emphasized that reusing cases after classification and collection would help the learning process in the future.

II. CBR and IBIS
Because CBR is an open way to deal with problems, which based on the concepts of accumulated experiences will be better than Rule-Based Reasoning (RBR) [5] in handling an unknown circumstance. A past case represents a past experience in CBR. Accordingly, if you need to solve this same kind of problem, you can use the same experience for reference. Therefore, we can use the CBR tool to recommend peers’ cases to students for reference.

IBIS provided a simple and formal structure to help a group of people who had no confidence get a better answer from discussions, conflicts and repetition opinions. So using IBIS is for the result that people can use discussions and communications to make their different concepts get the agreement through the three opinion quantities of issues, positions and arguments. The three quantities can be regarded as the information exchange quantity, which is more that means effectiveness in a discussion. Besides, the concept utility quantity using the issue concept from Q&A is the ability of extracting concepts and program segments from recommended cases. Therefore, after students get recommended cases, we can use the quantification of students’ Q&A in IBIS to analyze the achievement of recommended cases.

III. Research Methodology
There were 53 students taking the Java Programming Language course, so we used the JAVA concepts for analyzing students’ cases. Because each student’s case had different concepts, which were his knowledge representations could be referred by others, we would induce the classification of case characteristic, and have the unity description of the teacher’s reviewed content. After an online database accumulated these cases, we would use each curriculum concept for observing and
analyzing these cases, which were described as below:
1) First, we used the compiler to separate every student's case (or production) from wrong or correct case for analyzing and inducing curriculum concepts.
2) We got the correct and wrong concept model from above correct and wrong cases.
3) We put the correct and wrong concept model into student case concept model and revised the teacher's reviews of student's cases to be the descriptions of concepts, which were the annotation of student case concepts and were saved into case database.
4) Aiming on the representations of students' cases, we would describe the each student ability with concept description which was saved into student ability database.

Therefore, we could establish the match model from each classified concept type. Because we hoped to recommend cases to students immediately, we used the CBR-Works [6] to be the tool of recommendation. When CBR-Works got a student's concept ability from his past cases, the CBR-Works would use the upper match model to retrieve peers' cases, and then actively recommend them to the student.

Because we used a teacher's viewpoint to make up the match model, this was not sure that the match model could satisfy the student's need. After a student had referenced recommended cases and answered the Q&A, we would analyze IBIS information exchange quantity and concept utility quantity to diagnose these recommended cases. We adopted Data Mining's Classification method to analysis the different quantity of special concepts between students and cases.

### IV. Experiment

Every student's cases such as practices in curriculum were collected for the source of cases. Figure 1 was the framework of Case Base Learning (CBL) System including CBR, match model, and student case analysis model.

![Figure 1: The framework of CBL System](image)

We used C5.0 [7] as Decision Tree analysis software and set a threshold related to the case number and confidence in C5.0 to filter out new match rules. The decision achievement was IBIS information exchange quantity and concept utility quantity. We extracted each rule conformed to that the case number should exceed 5 (Cover>=5) and the Confidence should exceed 0.6. Therefore, we could get new rules from above results to revise the prior match model.

We used the questionnaire of user's acceptance of information technology from Davis [9] to understand the perceived usefulness and perceived easiness of students when using CBL system. After our statistic analysis of the perceived usefulness of the system from questionnaire, 69.3% students thought the system was useful, and of the perceived easiness of the system, 72.4% students thought the system was easy to use, so almost 70% students accepted the system.

### V. Conclusion

The experimental achievement showed the system could reuse the accumulated cases and support effective leaning. Students not only just got the difficult cases from teachers but also got the fitting cases developed by peers for problem solving, that is, these recommended cases would effectively activate their ZPD. On the other side, the burden of teachers would be reduced when the accumulated cases had grown up.

### References

[7] WWW URL for C5.0/See5.0: http://www.rulequest.com/