Teaching Knowledge-based System by Using Web- and Problem-Based Learning Approach

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Abstract—**This paper aims to introduce a web-based and problem-based learning instruction system for students and teachers of the CSIE. The PBL methodology and its' application to knowledge based system in AI course are discussed. And the web-based PBL system will be introduced in detail. In addition, we intend to encourage students to practice teamwork, self-study, data analyzing, and problem-solving, our research includes literature review, PBL instruction, interview, web-based system design, questionnaire and evaluation, etc.**

Index Terms—**Problem-Based Learning (PBL), Web-Based Instruction System, Knowledge-Based System.**

I. INTRODUCTION

Problem-base learning (PBL) is the methodology was firstly used by college of medicine in 1960 [8]. It is nearly student-centered, self-study method which show the significant different from the traditional method, not relying on teacher's lecture. Teamwork and problem-solving-oriented are the main characteristics of PBL method that lead students to obtain knowledge from the designed courses.

PBL is also applied to engineer's education and training, such as biomedical engineering, and chemical engineering. Now, the method is used to teach circuit analysis [3], network design course in electronic engineering department or computer science engineering department [5]. This kind of teaching method just approaches the expectants of engineer's education and training. Professional knowledge, social skills, ability of solving problems, and custom of independent learning can be brought up by PBL method. Obviously, the PBL method is required in engineers' career.

PBL means that the teacher selects a practical problem different from the traditional teaching material. Problem encourages students to get into PBL method processes (The statuses of PBL: STEP1 to STEP5) and group discussion. This process can educate students to learn actively, to think problem critically, and to solve problems correctly [2].

According to the above motivation, the purposes of the paper are:
1) To organize a web-based PBL teaching activity for knowledge-based system for the course in the computer science department [4];
2) To construct a web-based PBL instructional system for the knowledge-based system [10].

3) To evaluate the effects of the proposed approach.

Table.1: Distinction between PBL method and traditional method

Traditional method	PBL method
Teacher center	Student center
Knowledge comes from teacher's tuition	Knowledge comes from problem
Providing the teaching materials	Providing the impulse of course
Learning and examining	Solving problems and learning
Not really team work	Team work

II. THE TRADITIONAL COURSE AND ITS CONTENTS

Knowledge-based system teaching materials are always included in AI. The traditional material of knowledge-based system includes knowledge representation, reasoning (forward, backward chaining), knowledge verification (Redundancy, Conflict, Circularity, Incompleteness), and the real processes of knowledge engineer. Then the torturing of knowledge-based system in AI course is arranged after introducing predicate logic. Before the midterm, we suggest that teach students knowledge representation and reasoning. The knowledge verification and processing of knowledge engineer are introduced after the midterm.

Furthermore students also can hand on a small, PC-based, budget limited knowledge-based system for the semester project [6]. The grading of knowledge-based system sections in AI is 30% midterm, 30%final exam, 20% homework, and 20% of semester project respectively.

To pass the AI course included knowledge-based system sections requires obtaining at least 60% of the score in either one midterm or one final examination, each including the solving of five problems. The grading system is as follows: 0 = Fail (0%-49%), 1 = Pass (50%-59%), 2 = Satisfactory (60%-69%), 3 = Good (70%-79%), 4 = Very good (80%-89%), 5 = Excellent (90%-100%) [4].

III. PBL METHOD

In this section, we will illustrate the PBL method containing and arrangement.

Table.2: The roles of PBL method include teacher, student, and tutor.

Roles	Position
Teacher	Design the impulse, to be the supervisor
Student	Join the team, and discussion
Tutor	Help student to solve problem and clarify the new terms

The steps and organizations of PBL method and each individual should do: PBL mainly emphasize few things: teamwork, solve problem, and self study. A small team is formed up by 4 to 6 students. The small team helps students give and get peer knowledge from teacher's courses. The course should be a hint or an impulse, but not the key points or directly knowledge that comes from teacher's knowledge. Each of student team

comprised with a secretary, chairperson, usual members includes a supervisor; each one has their own job, but supervisor that might be the teacher that do not intervene works of the team. Anyone in the team will be the secretary, chairperson by turns in their team meeting or discussion.

The student can exchange knowledge even make some decisions though the regular meeting or discussion. They are also hold frequently in each statuses of PBL methodology.

The statuses of PBL: STEP1 to STEP5

STEP1: Clarifying terms

STEP2: defining Problems

STEP3: Analyzing problems

STEP4: Self studying

STEP5: Reporting

The structure is based on Maastricht model [2]. When a hint (or an impulse) is given, it is just describing a situation that used for inspiring students to define problems and solve them. But student do not understand the new terms that are imply or shown directly in the hint (or impulses) to them, so clarifying terms should be the first step. If there exist the new terms that all of group members do not know, the tutor can help them to clarify. The clarified terms are taken down by the secretary. The designed impulse will be raid carefully by students and get the problems that they should be solved. The defined problems are solved by students their self absolutely. The STEP4 contains systematic clarification and Formulating learning objectives. The skills of solving problems, experiences, knowledge that based on those solved problems still have to organized, grouped then set learning targets of current impulse for members.

According the learning target, members have their self study as previous for realizing the formulated knowledge. Reporting is the students' final job in PBL method, they not only report to teachers but also other teams. So, students can get knowledge from other teams and advices from teachers.

IV. IMPULSE

All the impulses and each impulse's learning subjects of knowledge-based system are listed as following:

☐ The impulse 1: An ill person goes to see a doctor.

People get to be ill, and go to see the doctor. The doctor always examines the patient's symptoms. According to these symptoms the doctor can diagnose what kind of illness the person got, and then make a prescription. For example, patient cough and snivel will be diagnosed the patient caught a cold. Human doctor can judge plenty kinds of illnesses by examinations physical symptoms and conditions. Deservedly, the same symptoms and judgment exists a simple form which is acceptable to computer, such as the rule. The value of cough and snivel is true, and value of catch a cold is true.

IF   cough and snivel

THEN   catch a cold

Can a computer help and serve the same things?

Subjects: knowledge based system, applications of knowledge based system, knowledge presentation, Different types of knowledge-based systems, such as case based, rule based, etc, Real example like, MYCIN, R1 etc.

A good impulse: An Ill person goes to see the

doctor which is real life and border. The learning target includes the basic knows about knowledge based systems, and knowledge presentation.

☐ The impulse 2: Reasoning.

Like the example of that ill person goes to see the doctor, the fact cough and snivel are true. After direct and simple reasoning by the rule "IF   cough and snivel   THEN   catch a cold", we can get the fact catch a cold is true. This is forward reasoning.

Subjects: Exact reasoning, forward reasoning, back reasoning, inexact reasoning is also considered in the course.
A good impulse: It includes some knowledge relative to impulse 01. And there is plenty of reasoning types which are mentioned in the impulse.

☐ The impulse 3: Journal papers.
Verification of Knowledge-Based Systems Using Predicate/Transition Nets [11]
Knowledge base verification [9]
Validation and reparation of knowledge bases [7]
Verification and validation of expert systems [1]

Subjects: Knowledge verification,   redundancy, conflict, circularity, incompleteness, Petri Net, etc.
A good impulse: Cover some relative concepts.

☐ The impulse 4 building up a knowledge based system

A knowledge based system is set up according to some knowledge in a specific domain which oriented from real word experts or engineers their self. And the system can serve like real experts in its ranges of applications.
Subjects: To set up an application domain of knowledge based system, knowledge engineers, finding out the tools.
A good impulse: The impulse is challenge for students. Students will experience the process of knowledge engineers, and play the roles of knowledge engineers, real experts of direct domain, user, and maintainers. Learners have to select a knowledge domain that they may visit and confer to the real experts, or they can be the expert by their self in their familiar knowledge domain. They should find out the suitable tools or software and turn the human knowledge to the form of the applications. And they can learn how to maintain the system of knowledge based system life cycle.

Students learn in the impulse 4 will get the chance to build a small, PC based, budget limited knowledge based system.

V. Web-based PBL system

An internet forum, impulses collecting, system features was designed for the PBL method, students' group, and teachers. For these features we have to design a web-based system with a server host, data based system to keep the necessary file of PBL method processing.
Functions

The main function of the system includes the chatting room for students' discussion, uploading and downloading files about learning, providing personal learning account management, learning and discussing recording, impulses collection, PBL

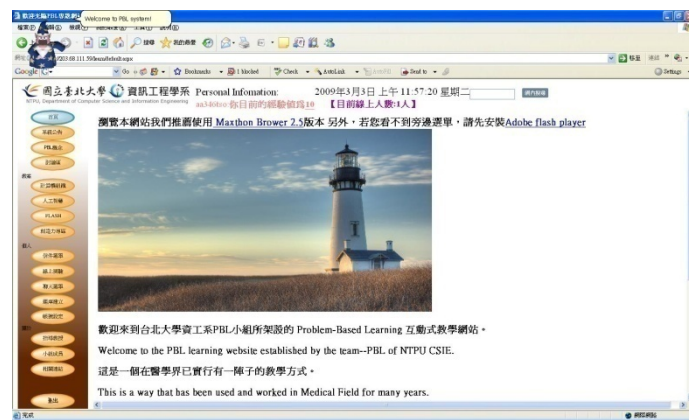methodology and experience sharing, news of the courses, etc.

Fig. 1: PBL Instruction System

For these functions and stable web-based system, we use the sever computer (HP ProLiant ML 110) as the host, and the server suitable operation system Microsoft Windows 2003. The server homepage and internet applications management application IIS 6.0 allows more than 10 users to access the service of the server at same time which is enough for a course took by less than 50 students.

Table.3: System design technique, tool, and programming language

Category	Software, tool and programming languages
OS	Microsoft Windows 2003 中文版
Server System	Microsoft Internet Information Server 6.0 (IIS5)
programming language	HTML ASP.NET ActiveX
Database	Microsoft SQL Server 2000

Benefits and design

Clients (students, tutors, or teachers) can use the web based system by their own PC connected to the internet, only if the sever is running. They have no need to install any applications or program in their PC, just using the web browser (such as IE, FireFox, etc) which is most common application in usual PC.

The designed web-based system solved the problem of PBL method needs the space like classroom or conference room for students' discussion, tutors' responses to students' questions. The time limitation is also busted; students can discuss and post their opinions to the learning projects in any hour a day.

The forum function of the system can also record the students' discussion, tutors' responses, upload teachers' materials or impulses. It is convenience for each to review what the lesson mention about or focusing on. Similarly, these four impulses we proposed are always store in the system for over viewing after PBL processing. As well, the forum helps teacher to score students' behaving in the team discussions.

VI. FEED BACK EVALUATION

Feedback on the AI course with knowledge-based system section is collected by asking the students to fill in a questionnaire on the Internet anonymously [5]. All of the students who take the course complete the questionnaires which results are separated with their personal data. The designed questions and each result which shown the percentage of student who agree the question in the questionnaire are used to evaluate satisfaction level, as the following:

Q1"The PBL sessions have improved my understanding of the lectures provided within this module."(95.238% of students agree)

Q2"The PBL sessions have helped my understanding of the theoretical network design process."(92.857% of students agree)

Q3"The PBL sessions were realistic and reflected typical real practical satiations."(85% of students agree)

Q4"The PBL sessions have helped my ability to work in groups." (85% of students agree)

Q5"The PBL sessions were well organized and effective."(92.5% of students agree)

Q6"The PBL sessions should be kept as part of this module." (92.5% of students agree that should be kept as part of this module.)

The questions of the opinions to that instructing in PBL or traditional method in the questionnaire are:

The response to Q7"How motivation do you fell the PBL method was?" is on the scale 1="less motivation" to 5="much motivation". The result of Q7 mean value is 4.19.

The response to Q8"How much harder did you work than usual?" is on the scale 1= "Not harder" to 5="Much hard". The result of Q8 mean value is 3.19.

The response to Q9"How well did you fell learned the course matter?" is on the scale 1="Poor" to 5 = "excellent". The result of Q9 mean value is 4.30.

The response to Q10"How was your learning experience?" is on the scale 1="Poor" to 5 = "excellent". The result of Q10 mean value is 4.11.

VII. CONCLUSION

Based on the above discussion, the students who take the AI course and learning from knowledge-based system materials show the great

interesting in guiding knowledge-based system by the proposed approach. This paper is sponsored by 98th academic year the Ministry of Education Teaching Excellence Award Program as a sub-project. The primary challenge may be designing the impulses that are suitable for each subjects of knowledge-based system in AI course. The secondary work is developing the web-based system for assisting students' learning. The final work we evaluate the problem and web-based strategy though students' filling the questionnaire. The results of students' response and awarding record exhibit a significant outcome.

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