3. Collaborative Teaching-Learning on the Web in Higher Education

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Abstract

This report consists of a brief description of a web based collaborative teaching-learning system. On the basis of cognitive model of instruction and following guidelines for instructional design, teaching-learning strategies for problem based learning have been discussed. This collaborative learning system has been designed in such a way so as to develop metacognitive skills, reflective thinking, decision making and problem solving strategies through integration of knowledge and information. The role of computer is to form mixed ability students' groups based on their prior knowledge, to provide strategies for problem solving, keeping track of all the information collected by the user at different time and to help organize information for ease of concept mapping, decision making and finally, problem solving by the students. The system as designed would provide guidelines for effective instructional design with appropriate examples for the benefit of the teacher. One of the effective uses of such an instructional system is to support work on a task undertaken collaboratively by a number of dispersed teachers and students. Using this system the teachers and the students can access the progress of an individual learner at any time. Based on the learner's progress teacher(s) can provide suggestions and guidance to the students in the form of a tutorial and feedback session. Students on the other hand, can hold discussion, seek clarification about any information or idea from each other. Computer helps in the assessment of performance of each student by manipulating the information obtained from peer review and teacher's judgment. The results of assessment are represented in graphical format for better visualization of ones performance as an individual learner and as a member of a group. Regarding future directions, this paper discusses the development of web based tool for production of cognitive maps.

Introduction

Studies on human cognition treat human beings as agents in a distributed cognitive system rather than as independent cognitive systems (Nardi, 1991). Studies of computer-supported cooperative work show that a computer-network system provides a useful way for people to function as a distributed cognitive system in conducting complicated task (Galenger, Krant and Egido, 1990). According to (Hoffman and Ritchie, 1997). Learners with related but different interests can customize multimedia PBL environments to problems and problem spaces that meet their need. All these, and many more research findings and relevant literature review

motivated the author towards the design of a model of PBL (Madhumita and Akahori, 1997a). The proposed model shows that there are three kinds of learning taking place through PBL approach.

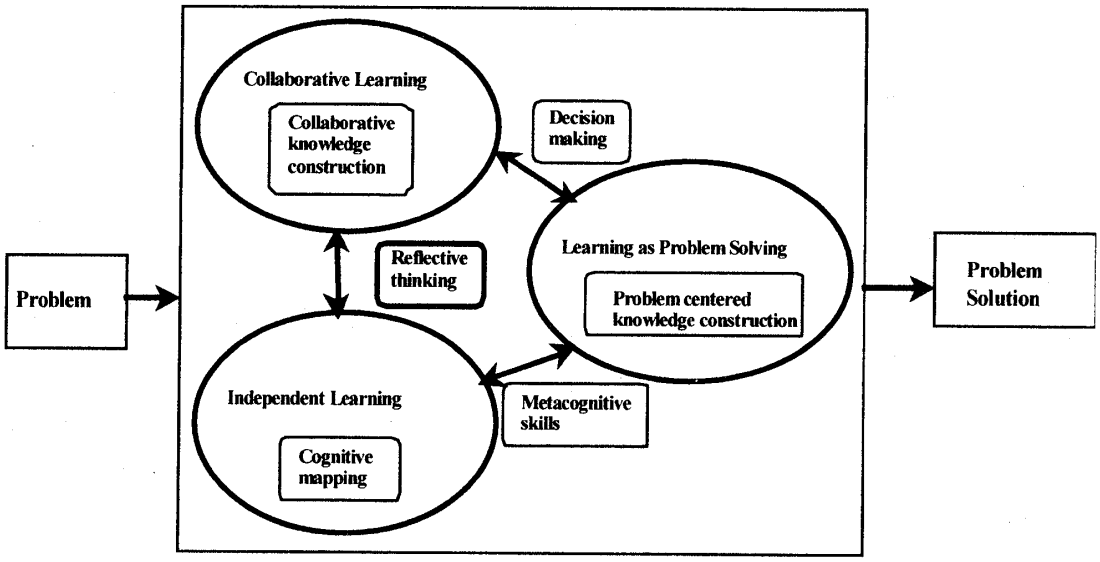

Figure1: The Model of Problem Based Learning

This PBL system would provide online training to faculty for implementation of PBL in order to develop students' metacognitive skills, reflective thinking, decision making and problem solving strategies through integration of knowledge and information. A set of cognitive strategies has been derived for PBL by collecting data from actual subjects (Madhumita and Akahori, 1997b). The system as designed would provide guidelines for effective instructional design with appropriate examples for the benefit of the faculty.

One of the effective uses of such an instructional system is to support work on a task undertaken collaboratively by a number of dispersed teachers and students where students includes trainee teachers. Using this system the teacher can access the progress of an individual learner at any time.

The Functional Model of the System

The functional model (Madhumita and Akahori, 1998a) of the present PBL system (Figure 2) consists of mainly two parts the Teacher Module and the Student Module. Further the Student Module is divided into two parts, one for Individual Learning and the other for Collaborative Learning. The teacher is able to access all the input information from Student Module at any time. The individual learner can access relevant information from teacher module and all the information from the common area of collaborative learning.

The detail description of each phase of the system has been given in the article on Design of a Collaborative Distance Learning System (Madhumita and Akahori, 1998b). We may say

sooner or later in PBL curriculum, faculty from different disciplines will find themselves teaching together. If this is practiced then this will add another dimension to the present system as a computer-supported instructional system for team teaching and collaborative learning at a distance through the Internet.

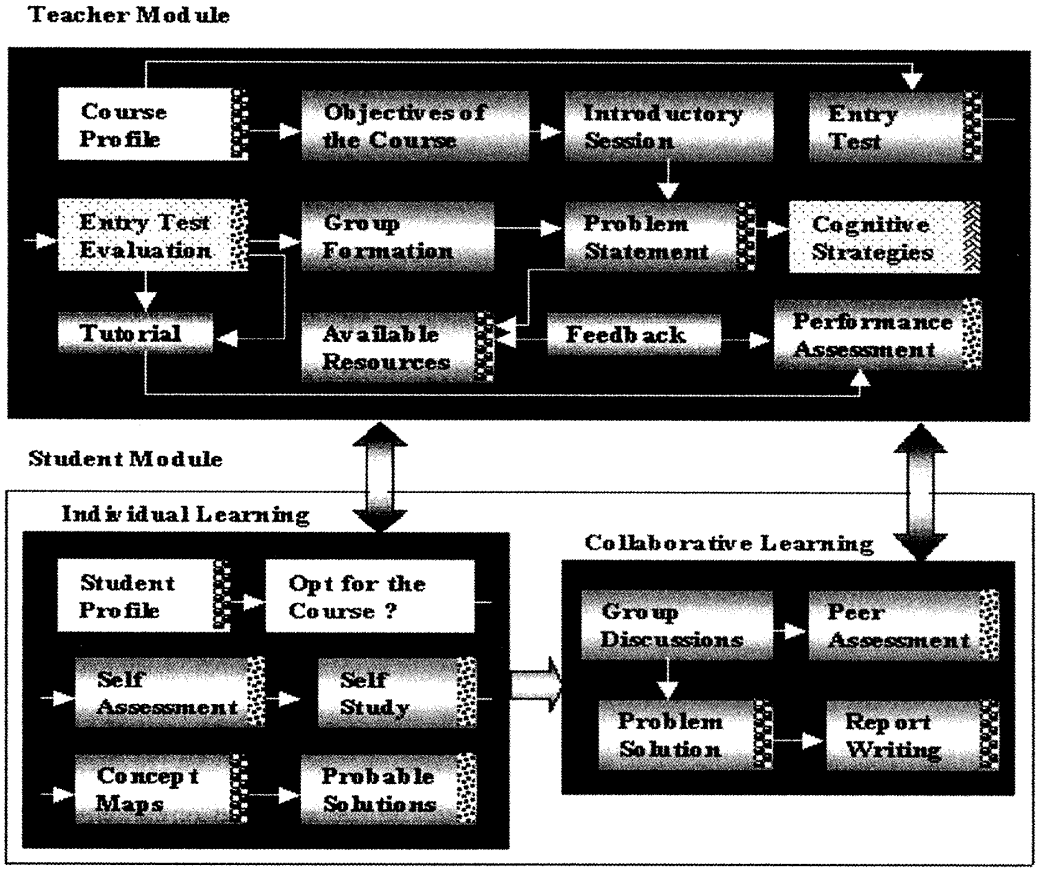

Figure 2: The Functional Model of the System

Pedagogical Principles

Pedagogical aspects which has been taken into consideration for developing the present web based tool for PBL (Madhumita and Akahori, 1998c) are:

1. Entry Test

Entry test has been used to check the adequacy of the possessed knowledge and skills for solving a problem. Based on the result of the entry test the student is provided feedback so as to progress further. Students who score less than or equal to 60% marks are subjected to a tutorial session in order to update their knowledge about a specific topic.

2. Specific Objectives

Formulation of specific objectives has been considered as an essential part for a course. The specific objectives serve the dual purpose of providing guideline for self-study and the expected out come to the student.

3. Introductory Session

The session introduces the students to a particular course. The introduction thus provides a background of the course. This allows the students to feel comfortable and familiar with the course and they get some sort of confidence before facing the actual problem. Students also get information about the available resources for solving problems in a course.

4. Cognitive Mapping

Although cognitive mapping is not considered as one of the essential element of traditional PBL but in our system it is one of the important manifestation of learning. As noted by many researcher cognitive maps are a valuable and important means of knowledge representation. They have significant potential as group interaction tool. According to us congnitive maps produced by the students in the individual learning phase is a crucial element. The faculty could investigate a learner understanding of a topic by viewing the concept map produced by the learner. Cognitive mapping has been recommended as study strategy (Reigeluth, 1979), as a means of representing structural knowledge in a given discipline (Diekhoff and Dielchoff, 1982), as a means of increasing recall of written text (Rannch and Ellenworth, 1980) and as a powerful assessment device. Accordingly the faculty could provide feedback to the learner. In this way one can visualize the process of conceptual changes taken place during the problem solving due to various interactions among the learners and with the faculty. We have recently conducted an experiment in order to find out effectiveness of cognitive maps for discussion (Madhumita, 1999b).

5. Cognitive Strategies

Most educators agree that problem solving is among the most meaningful and important kinds of learning and thinking. Problem solving, as an activity is more complex than the sum of its component parts (David H. Jonassen, 1997). In our system we have introduced based on our previous research (Madhumita and Akahori, 1997b) list of thirteen different cognitive strategies (as listed in Table 1) used by the learners for problem solving. The faculty could select the strategies according to the problem statement. Also if faculty thinks that the problem in hand requires some additional strategy which is not covered by the given thirteen strategies then in that case the faculty could add one or more strategies for solving a particular problem.

Table 1: The Strategy Table

StrategyID	Strategy	CategoryID
1	Discuss with peer for better understanding	Collaborative Learning
2	Discuss with expert when stuck or for interpretation	Collaborative Learning
3	View the problem from different perspective	Collaborative Learning
4	Break the problem down into subtasks	Collaborative Learning
5	Distinguish between known and unknown	Individual Learning
6	Make a graphical representation of the problem	Individual Learning
7	Fill up the information gap through study	Individual Learning
8	Think on the problem and document the thought	Individual Learning
9	Always keep objectives of the problem in view	Learning as Problem Solving
10	Apply methods according to problem characteristic	Learning as Problem Solving
11	Management of time and attention	Learning as Problem Solving
12	Reach the best solution using elimination	Learning as Problem Solving
13	Sum up for understanding at the level of generation	Learning as Problem Solving

6. Thinking Skills

PBL inculcates higher order thinking skills. Web technology provides a ground for fostering these thinking skills such as synthesis of information through its linking and cross-referencing capabilities. Students and teachers alike can expand their own knowledge base and demonstrate the value and necessity of life long learning. By using the present system the students learn to model critical thinking skills and problem solving abilities.

7. Collaborative Learning

In management, cognitive maps has been proposed as a means of representing the conceptual structures under lying decision making. In our system web environment has been used both as tools for group-process support and as the production environment of the PBL through production of report writing. In the process of collaborative learning students could practice different group dynamics and decision-making strategies. Our goal in implementing Internet tools for group formation was to eliminate spatial inequalities inherent in a hybrid classroom. The hypothesis was that such tools could enable the same, if not better, degree of peer interactivity characteristic of a physically co-located classroom. In this regard we have conducted synchronized and asychronized collaborative discussion sessions using the Web as a media (Madhumita, 1999c). Figure 3 and Figure 4 are typical examples of a before and after discussion (on the web) cognitive maps.

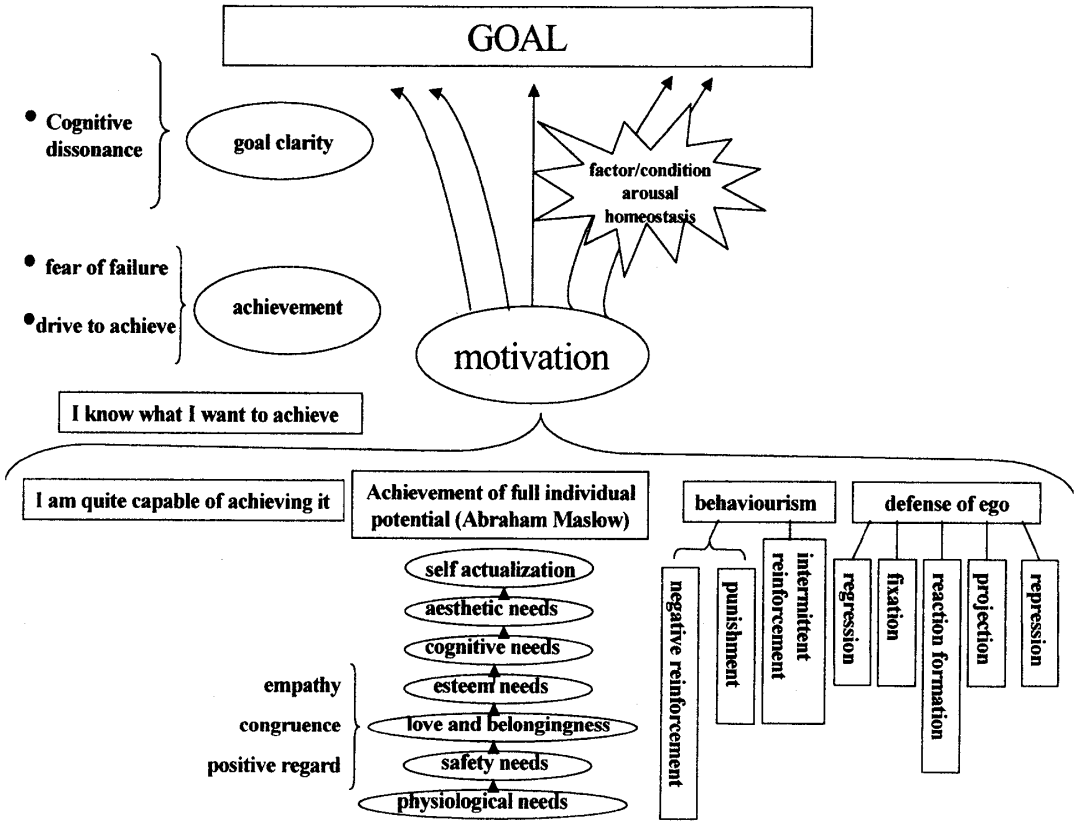

Figure 3: Before Discussion Cognitive Map (based only on Self-Study)

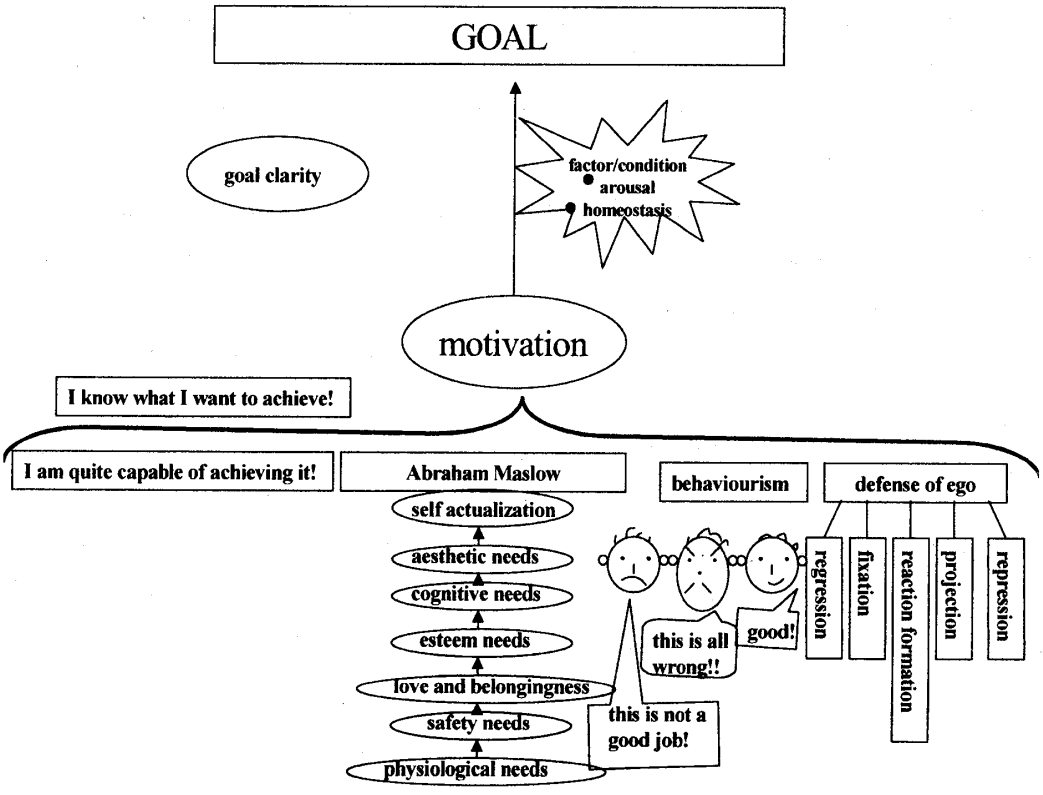

Figure 4: After Discussion Cognitive Map (modified based on the discussion)

8. Feedback and Evaluation

Students are provided with informative feedback on their concept maps by the faculty. According to these feedback messages the student is allowed to modify his/her own concept map.

An evaluation tool has been developed to support evaluation of the problem solution by the students of a particular group (known as peer assessment) and the faculty concerned. Use of evaluation tool integrated in the web site allows efficient registration of students' and teacher's feedback and immediate visualization of students' progress.

Collaborative Evaluation

In problem-based learning "process assessment" as well as "outcome-oriented assessment" are essential. The "process assessment" have a beneficial effect on student learning and for "outcome-oriented assessment" should focus on application of knowledge in problem-solving situations (Swanson et. al. 1991). We have adopted the collaborative evaluation procedure in order to evaluate an individual student in the cognitive, affective and interpersonal domains of learning while the learning is taking place through self learning, collaborative learning and learning as problem solving in a WWW based PBL environment. With this system we would be able to evaluate learning by going through the PBL method and also as a product, i.e., application of knowledge gained by solving problems, in the form of multiple choice items developed by the teacher (Madhumita, 1999a). We have identified five items for each of the three rating scales, viz., SR, PR and TR. These items are identified in such a way so that it would provide the opportunity to evaluate a learner from three different perspectives including his/her group activities and individual learning.

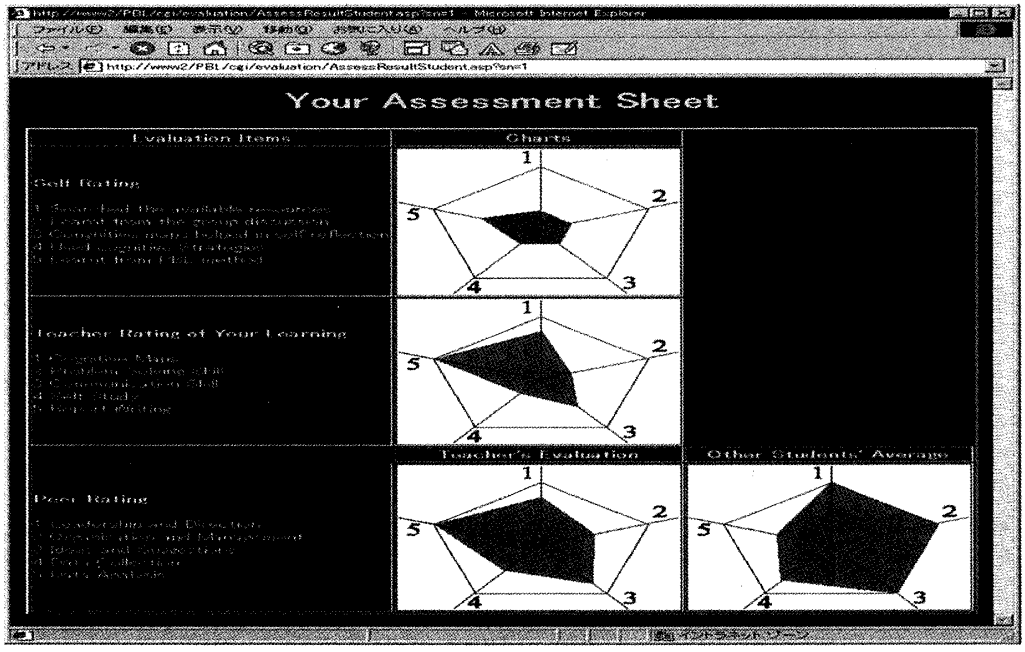

Figure 5: Assessment Results for a Student

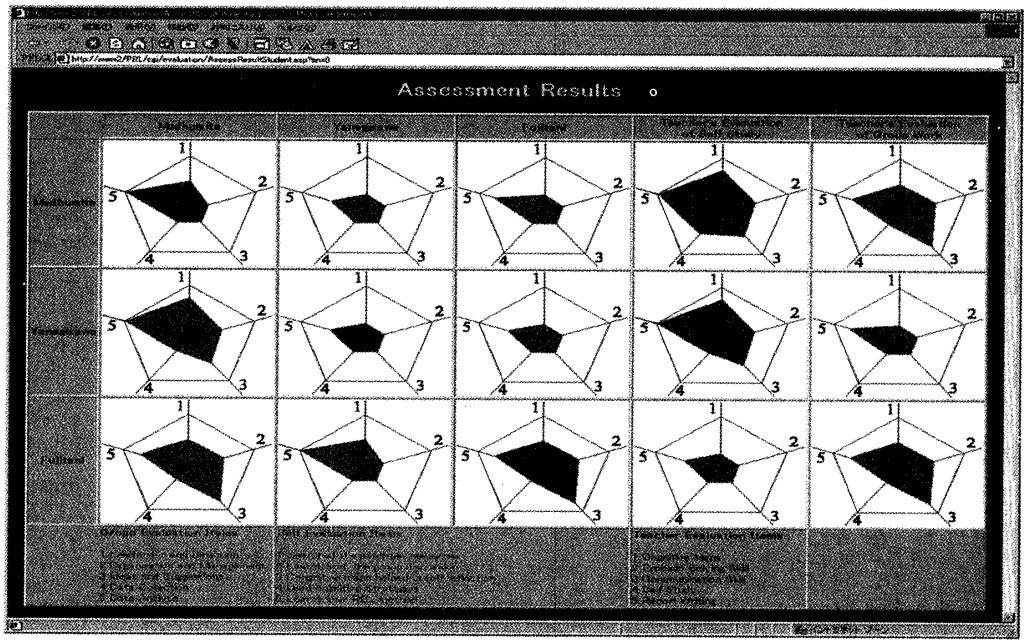

Figure 6: Assessment Results for a Group

The data received through the input screens could be stored in MS Access databases. The data are then analyzed and shown on the output screens as illustrated in Figure 5 and Figure 6. The pictorial view of the analyzed data made it easy for deriving conclusions from the represented data.

Conclusion

The system as described in these pages has been envisaged with the aim of implementing and popularizing the problem based learning. Problem based learning has been recognized as one of the effective method of teaching-learning particularly in higher education. In the present work, an effort has been made to construct a new kind of learning environment on the web, which enables collaborative distance learning from work or home. This facility adds a social dimension to learning and help learners' to develop their own thinking further. This also supports the theory of constructivism in which the basic idea is that the learner must construct his/her knowledge and skill through his/her own experiences. In other words this is the essence of problem based learning.

We have developed an instructional framework for developing and delivering problem based learning curriculum. We have used HTML and Visual Basic Script for programming and the databases have been developed in MS Access. We intend to develop a web-based tool for producing and editing of cognitive maps by using ActiveX.

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