EFFECTIVENESS OF WEB BASED PBL USING COURSE MANAGEMENT TECHNOLOGIES: A CASE STUDY

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Abstract: Maritime education and training has typically focused on delivering practical courses for a practical vocation. In the modern environment, maritime personnel now need to be more professional, more open to change and more business-like in their thinking. This has led to changes in the education system that supports the maritime industries. Teaching thinking skills has become a major agenda for education. Problem Based Learning is a part of this thinking. Problem-Based Learning (PBL) within a web-based environment in the delivery of an undergraduate courses has been investigated. The effects was evaluated by comparing the performances of the students using the web-based PBL and comparing the outcomes with those of the traditional PBL. The outcomes of the experiments was positive. By having real life problems as focal points and students as active problem-solvers, the learning paradigm would shift towards the attainment of higher thinking skills.

1 INTRODUCTION

The Problem-Based Learning (PBL) approach is not new to training. Since its implementation in medical training in the early sixties (Thomas and Chan, 2002), the parameters of education have taken on new dimensions with the world becoming more compact, and information more fluid and immediate. The rapidity of knowledge change means that learners have little time to reflect on the knowledge presented. They most often surface learn the area of knowledge and then discard it as soon as the need is over. They prefer to be directed in the learning agenda and choose to be told rather than search to find out information. In line with the new work environment "where workers are given increased responsibilities, including individual and team based goal-setting responsibility and greater latitude to achieve these goals", it is felt that learners need to be given more opportunities for self direction (Gijselaers and Segers, 2002).

The advances of Computer Mediated Communication (CMC) present an enormous shift in the manner in which PBL is conducted. The provision of synchronous and asynchronous collaboration and the availability of enormous and ever expanding course related web-pages and materials provide a new dimension to the PBL approach. The process of PBL that requires the individual to seek information and knowledge to construct new understanding, meanings and concepts and the collaboration between peers towards the solution of authentic and real-world problems can be readily supported by current communication media based on the computer and ICT (Corderoy and Copper, 2000).

Apart from the role of CMC in supporting the process of conventional face-to-face PBL, attempts have also been carried out to incorporate the entirety of the PBL learning processes in the web based learning environment suitable for the delivery of courses in open and distance learning (Dick and Carey, 1996),(Harper-Marinick, 2001),(Koschmann, 2002),(MacAlpine and Clements, 2001). In open and distance learning, there exists a spatial and time gap between students and teachers and the ability of CMC to surmount the physical and temporal constraints makes a web-based PBL approach for

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course delivery particularly useful and advantageous. The web-based PBL involves the creation of instructional materials that facilitate problem presentation; the required self-investigations and analysis can be conducted through online resources and the social interaction for peer-peer collaboration and student-teacher facilitation can likewise be easily performed through asynchronous forum boards or synchronous chats. The final presentation of the answers to the problem can also be easily conducted through the array of educational media technology tools made available by CMC.

There have been several studies that attempt to evaluate the effectiveness of web-based PBL (Norman and Schmidt, 1992) Reported that students perceive the web-based PBL to be motivating, providing access to greater richness of resources and developing collaborative networks; the skills that they subsequently acquire are appropriate for their future professional activities. (Orill, 2002) Revealed that with a higher degree of student control related to aspects such as content, the instructional path, pace and feedback, the PBL approach contributes significantly to improved cognitive gains. (Ronteltap and Eurelings, 2002) Highlighted that the combination of synchronous and asynchronous tools in the web-based PBL leads to deeper levels of information processing when students compose documents that represent their personal knowledge based on their research from online resources.
The importance of the web-based PBL especially for course delivery in distance and open learning, a study that attempts to evaluate the effectiveness of this approach relative to the widely available online Content-Based Learning (CBL) both in terms of students' performances and perceptions (Gijselaers and Segers, 2002).

According to (Chickering and Gamson, 1991) and Chickering and Ehrmann, 1996), positive online-learning environments incorporate seven principles of good teaching practice. These should include:

- encouraging students-faculty contact,
- encouraging cooperation among students,
- encouraging active learning,
- giving prompt feedback,
- emphasizing time on task,
- communicating high expectations, and
- respecting diverse talents and ways of learning.

One important outcome of any educational effort is to prepare the candidate to face the challenges in the working environment. How can that be measured? Donald Kirkpatrick's model can be used to address the knowledge, skill & abilities needed to successfully apply the online learning material in the "real world" (Kirkpatrick, 1996). Kirkpatrick's four evaluation measures are reaction, learning, behavior, and results.
For the evaluation of the relative effectiveness web-based PBL and traditional PBL we will find the answers of the following questions:

1. Effectiveness of the web-based PBL environment compared with traditional PBL in terms of students academic achievements

Table 1: Kirkpatrick's four levels (Alliger, et al. 1998, Tannebaum 1998).

Level	Definition	Questions Addressed	Guidelines for Measuring Each Level
Level 1: Reaction	Assesses participants' initial reactions to a course. Offers insights into participants' satisfaction, or the effectiveness (value) of the training as perceived by the trainee. Usually assessed through a survey aka a "smiley sheet." Does not measure learning.	Were the participants pleased? What do they plan to do with what they learned?	Determine what you want to find out. Design a form that allows questionnaire results to be easily tabulated. Encourage honest written comments and suggestions. Attain an immediate response rate of 100 percent. Develop standards. Measure reactions against the standards and take appropriate action. Communicate participants' reactions. Use focus groups to acquire qualitative feedback (i.e. more specific comments)
Level 2: Learning	Assesses the amount of information (principles, facts and techniques) understood and absorbed by trainees. May use a criterion-referenced test	What skills, knowledge, or attitudes have changed? By how much?	Use a control group, if feasible. Evaluate knowledge, skills, or attitudes both before and after the training. Attain a response rate of 100 percent. Use the results of the evaluation to take appropriate action.
Level 3: Behavior, or Transfer	Assesses the amount of material used on-the-job after taking the course, e.g. a week to 6 months (or longer) after taking the course. Assesses on-the-job behavior based on the objectives of the course and assessed through tests, observations, surveys and interviews.	Did the participants change their behavior based on what was learned in the program?	Use a control group, if feasible. Allow enough time for a change in behavior to take place. Survey or interview one or more of the following groups: trainees, their bosses, their subordinates, and others who often observe trainees' behavior on the job. Choose a statistically significant sample, or 100 employees. Repeat the evaluation. Consider the cost of evaluation versus the potential benefits.
Level 4: Business results	Measures results, e.g. reduced costs, higher quality, increased production, and lower rates of employee turnover. Measure 6 mos. to 2 yrs. after completing the course.	Did the change in on-the-job behavior positively affect the organization?	Use a control group, if feasible. Allow time for results to be achieved. Amount of time depends on course context. Measure both before and after training. Repeat the measurement. Consider the cost of evaluation versus the potential benefits.

2. Students perceptions
3. Teacher perceptions

The results of the research questions could provide institutions with alternative delivery methods through open and distance learning. Also, this will lead the students to deeper levels of information processing when students compose documents that represent their personal knowledge based on their research from online resources.

2 THE DESIGN OF THE SYSTEM

In order to examine the effectiveness of web-based PBL in terms of the students' academic enhancement, specially designed web based systems were developed and installed online. The system was designed according to the PBL approach which acted as an experimental system that would include the tools to support traditional Content-based sitting in classroom.

For the conference room we provided some tool to the users that were included within the synchronous distance learning environment. These tools include, Discussion Forum, File Exchange, E-mail, Real-time Chat, Video Services, and Whiteboards. All mentioned tools ware developed by using flash scripting and PHP programming language for all the user interfaces. (Cakir and Basak, 2005)

2.1 Student Evaluation of the Course and the Instructor

Student learning was evaluated using the Teaching Effective Questionnaire (TEQ). The TEQ instrument consists of 10 items that ask students to rate the instructor and the course on a Likert scale ranging from 1 to 5 with 1 being strongly disagree and 5 strongly agree. The items and the mean scores on each item are shown in the Tables below. The mean scores are reasonably high and comparable to those obtained by the author for a similar course taught in a traditional face-to-face PBL classroom. The other tables show the mean scores for a similar class taught by the same author in a WEB based PBL Clasroom environment.

2.2 Evaluating Students Learning

Use of multiple assessment techniques is necessary to derive reliable results when evaluating students learning outcomes. In this course, students' learning outcomes were assessed by a variety of means that include individual assignments, group projects, participation in weekly chat sessions, participation in bulletin board discussions and participation in group discussion sessions. In each of the activities, students were graded based on a rubric which is specific to that particular activity. The rubric for each activity is available to students at the beginning of each activity so that they know exactly what areas they will be assessed on. Table 1 shows a rubric that was used to grade the first simulation project. The assessment techniques are quite comprehensive and thorough, and because of the fact that comments are written, which usually requires more effort from both the students and instructor, it means there is a lot of detail involved. One of the advantages of this is that all communication between instructor and students is automatically archived. Faculty members and students can access transcripts of past chats to determine levels of participation and accuracy or to review guidance and explanations. Providing students with immediate feedback is another practice that helps students derive maximum benefit from the online learning experience. Actually, in this course students consistently pointed out that the one thing they appreciated most was the immediate feedback they received on their assignments and projects.

Table 2: The mean scores for the items Traditional PBL Room scores.

Instructor	Questions	Score From Traditional	Score From Online
	Explained Course objectives clearly	4.12	4.32
	was well prepared for class sessions	3.24	4.97
	made effective use of class time	4.51	4.46
	Explained concepts and ideas clearly	3.22	4.11
	Answered questions in a helpful way	3.47	3.20
	was willing to meet with students outside of class time	3.41	4.32
	assigned grades fairly	4.24	4.43
	made the course content interesting	3.24	4.11
	significantly increased my understanding of the subject matter	4.32	4.14
	instructor is an excellent teacher	4.22	4.71

$Mean_A$—$Mean_B$ =-0.478 **t**=-2.42 **df**=9 **P**=0.038611

Table 3: The mean scores for the items Scores on both Sites about Scenarios.

Scenarios	Questions	Score
	Story	3.31
	Fluency	4.11
	Learning goal	4.53
	Real life	3.89

Table 4: The mean scores for the items Problem Based Learning Group.

Group	Questions	Score From Traditional	Score From Online
	Performance in group	3.44	4.01
	Share knowledge	4.10	4.37
	Attending activities	3.73	4.24
	Tried enough	3.82	4.14

$Mean_A$—$Mean_B$ = -0.4175 **t=** -5.76 **df=** 3 **P=** 0.010399

Table 5: The mean scores for the items – Myself.

Myself	Questions	Score From Traditional	Score From Online
	Use of knowledge	3.21	4.60
	cross-examine	4.49	4.01
	Communication	4.22	4.72
	Contribution to group	3.51	4.12
	Evaluation ability	3.84	4.51

$Mean_A$—$Mean_B$ = -0.538 **t=** -1.8 **df=** 4 **P=** 0.146238

Table 6: The mean scores for the items - Scientific Consultant.

Scientific Consultant	Questions	Score From Traditional	Score From Online
	Behavior of Consultant to you	3.61	4.64
	Knowledge of Consultant	4.56	4.06
	Time spend to solve your problem	4.29	4.73

$Mean_A$—$Mean_B$ =-0.3233 **t=** -0.73 **df=** 2 **P=** 0.541316

In general, traditional PBL room teacher uses a whiteboard, handouts and pre-prepared documents for students. Books and library resources are also provided online to the learners. Students read research and prepare themselves for the class before the lecture hour. In the lecture, students discuss the solutions of the problems given, writing findings on a white board in a face to face collaboration and discussions environment by tool with the teacher. Students can use their online statistical analysis tools for finding solutions to the problems. On the other hand, online PBL room, we provide all necessary tools like calculator, statistical web based mathematical tools to support the online collaboration (macromedia, http).

The system has been tested by eight students. The system consists of three sittings that consist of at least 4 sections. Each section has an unstructured problem to be solved and at least 5 to 8 questions about the problem. Students discuss the possible solutions of those problems. On each answer students discuss with collaborative environment provided by the system and the possible outcomes are noted on the whiteboard provided to them. In the traditional PBL room students are evaluated by the teacher whose performances are evaluated during the PBL session. For each session the teacher fills these forms manually and these files are collected by the department for the end of semester grading performance. Students also evaluate the teacher which questions are explained in the above tables. These results are collected by the department also for the evaluation grade of the teacher at the end of the semester.

Processes explained above, are moved online with all the facilities and tools provided to both parties. Moreover, we provide more tools for the students that are not available in a traditional PBL room like, a statistical mathematical package for WEB. Library links are also provided for easy access to the materials that supports the online PBL classroom. For online collaboration, we provide synchronous voice, video and chat tools which are effectively supported by Macromedia Inc. (Poon et al., 2004). To support real time transport we have used the Real Time Transport Protocol which is highly supported nowadays by IP networks anywhere in the world. However, for rural area low speed internet connections we provide lower rate video frames like 10 frames per second.

The system has been implemented at the department of Maritime Business and Management of the Dokuz Eylül University.

PBL System

The experimental web-based PBL system as explained in the above paragraphs was used in an undergraduate course at Dokuz Eylül University. The design was adapted on the model suggested by Harper-Marinick (2001) and consisted of the following sequences of learning,

1. **Introductory information** – introducing the process of PBL and the role it should play to accomplish the learning tasks.

2. **Presentation of an ill-structured and real-world problem** – serves as the organizing centre and context of learning.
3. **Online collaboration** – discussion among peers to propose the hypotheses and identification of learning issues. The group subsequently delegated responsibilities to each individual to find out more information about learning issues.
4. **Online resources –** each individual was engaged in individual online research on the learning issue assigned to him.
5. **Follow-up online collaboration** – students reported on the research done, identifying overlapping issues, and discussing the new hypotheses and learning issues.
6. **Solution to the problem -** students collectively agreed upon the solution of the problem and the plan of the presentation.

3 RESEARCH METHODS

The sample in the present study consisted of first-year undergraduate Maritime Business and Management students, a group tested by the department of Maritime Business and Management at Dokuz Eylül University in the 2005-2006 Fall Academic semester. Total of 8 students enrolled in this test. All students were the third year students who have a three year traditional PBL experiment. The schematic representation of the experimental design is given in Figure 1. The measured dependent variables in this study were the knowledge enhancement both in terms of academic performance and students' perceptions. The independent variables were the instructional design of the web page.

The post-test consisted of subjective questions listed above, assessing and evaluating the students' actual academic attainments and understanding pertaining to the respective lesson's learning objectives.

A test involving a different sample was also carried out to ensure the internal consistency of the formative questionnaire as well to improve the design of the Web based system for the experiment. The data collected were analyzed using a standard statistical package.

4 DISCUSSIONS

Tables 2-6 show the comparative analysis between the means of the traditional PBL room and online PBL room approaches. As can been seen, there is no significant difference between the mean marks of the two approaches, implying that both groups were homogeneous in terms of the background knowledge before the treatments were carried out. Any discrepancy that might have existed in the background knowledge between the samples prior to the treatment would not have any influence on the results of the comparative academic performances and perceptual analysis.
It is evident that both approaches produced a consi-

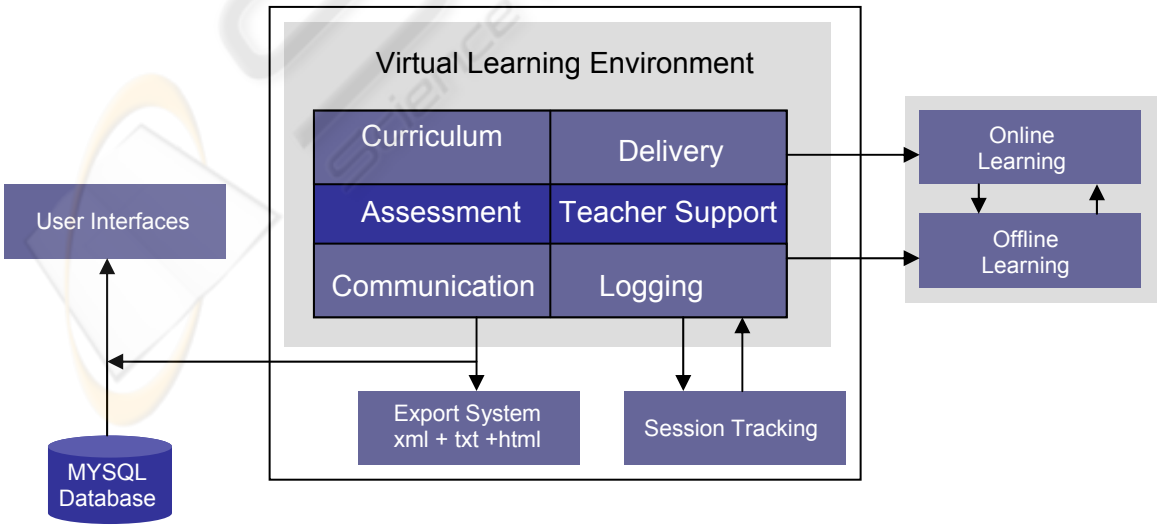

Figure 1: Online Problem Based Learning Support System Design.

-derable enhancement in terms of the knowledge constructed by the students. However,when the two approaches are compared, it is evident that the PBL approach yielded a superior learning enhancement.

The students' perceptual analysis in terms of knowledge enhancement was carried out by comparing the questionnaire between the two approaches. The results of the analysis are shown in tables 2-6 with no significant difference between the two approaches. Nevertheless, it is interesting to note that all the items recorded higher mean values for the online PBL approaches. It is, therefore, quite evident that these results highlighted the advantageous features of the online PBL approach as perceived by the students. The higher knowledge enhancement through the PBL approach perceived by them complemented the above findings of superior academic performances following the application of the online PBL approach compared to the traditional approach.

5 CONCLUSIONS

The effeciveness in teaching business and management online can be as effective as classroom teaching especially when instructors use content to help students acquire learning skills, use content to promote self-awareness of learning by students, and let students use content so that they experience it firsthand. The effectiveness of the online web based PBL approach both in terms of the students' academic performances and perceptions compared to the commonly available traditional PBL and web based online PBL approach. The results show that the web-based PBL approach has the ability to perform the web based approach.

Other advantageous features of the WEB based PBL approach have also been indicated, such as learning through social interaction, acquisition of kills in metacognitive reasoning and proficiency in problem solving in the workplace context. As such, efforts should be taken by the institutions of open and distance learning to consider the web-based PBL approach as one of the mechanisms for the delivery of courses in their educational program.

The most important issue is not whether business and management should be taught online or in a classroom, the issue is whether the course promotes a learner-centered approach. A course is likely to achieve its objectives if students become the center of the instructional universe, and when the content functions as a means as well as an end of instruction.

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