VIRTUAL LEARNING PROCESS MODELED WITH PETRI NETS

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ABSTRACT

The aim of this work is to offer a consistent methodology for the web-based learning problem in practical affairs. ITESM campus Toluca and Fachhochschule Esslingen are working together to provide their students with access to the Virtual Laboratory program. ITESM Campus Toluca has implemented a complete web-based methodology using the Blackboard (Bb) platform. This methodology has been modeled using Petri nets and allows both case students to work in an ordered and efficient way using the Project Oriented Learning (POL) technique.

KEY WORDS

Web-based POL training.

1. INTRODUCTION

The Virtual Laboratory project began in the year 2001. It’s a coordinated work between two universities to give their students a chance to work together, to solve problems considering a different point of view, to learn new languages and to exchange cultures[1]

All technical work had been done by the time when Virtual Laboratory was launched, but a complete methodology and the appropriate working platform were missing. The main contributions of this paper are:

- We present the Virtual Laboratory project over a powerful, consistent and largely used platform; Blackboard.
- We offer a reliable methodology for the web-based problem using the POL technique.

The web-based learning problem is not new, several projects have been already done, each concerning a different approach. Some related projects are: Team learning in an online lab [2], where the authors present a distance-learning experiment. In the paper Project Oriented Internet-Based Learning in the Field of Control Engineering [3], the author works in an environment based on MATLAB and web tools.

In order to work with a consistent methodology it has to be validated first. Because of that the methodology must be modeled using a trustable approach. We used Petri nets as the modeling tool since it allows to test and validate the final model to ensure the proper implementation. Petri nets basis theory and properties can bee seen in [4].

Today, Virtual Learning Environment (VLE) implementations are in full swing at more than 40 colleges and universities across the United Kingdom. Although each institution’s reasons for implementing a VLE vary—one fact remains constant: virtual learning is taking the UK by storm. When reviewing the VLE landscape, institutions typically evaluate a number of vendors based on company vision and reputation, support of open standards such as IMS, ability to scale, and ease of use. One platform consistently ranks at the top of each institution’s shortlist: that platform is Blackboard® [5].

Project oriented learning (POL) is a method where groups of students are actively engaged in trying to solve or address real-life professional problems and/or situations. The benefit of such an approach, is that they learn how to interact with one another and the community around them, they learn skills, gain knowledge, develop attitudes and behaviors which will allow to cope better in a work scenario after completion of there studies [6].

2. METHODOLOGY

The students work on a platform called Blackboard, they have all the information of the course there and can be asynchronous learning. To have practice or to get assistance from the teacher, the students must reserve the session time which give us synchronous learning. Figure 1 shows how students can log-in a server via a web browser to practice with their assigned real hardware project.
The objective of the POL is to have a learning process in the action, that means that the student learns developing, he gets the appropriate methodology to deal with the kind of problems that he will find in his future careers. It’s also expected that the student learns to learn.

There are three different types of methodologies to apply when using the POL technique [7]. For example, a) different courses with their own project, b) different courses with just one integrating project at the end, and c) different courses and one project simultaneously. The one we chose is (b) as shown in figure 2.

A project is a process that consists of the stages shown in figure 3. solution

2.1. Problem definition

Everything begins when the course is still closed. Student must register, pay, etc. The course is opened and students can log in the Blackboard platform by giving the correct id and password. Once into the platform students can check objectives, working plan and project assignation. There are two projects in the platform, two teams can work almost asynchronously in the projects, except for the professor and practice time that must be set. Teams begin their projects at the same time and they finish any time after completing all the practice sessions.

The course begins when students read the tutorial, it’s a complete manual describing all the technical background needed for the project. All doubts can be solved by reserving advising time in the Bb virtual classroom from here to the end of the course. After studying the tutorial students have to take and approve a test.

Next step is to prepare the project scheme, that means, students must chose the appropriate modeling tool, model the assigned system and validate it. If validation is successful students are allowed to start their practice time in the Virtual Laboratory.

Virtual Laboratory time is limited, so students must reserve server time to virtually practice with the system. Task begins when users implement their model, test the system and correct all possible errors. There are a maximum of 10 practical sessions and unlimited advising sessions. At the end of the sessions projects must be integrated as an unique project.

After every practical session students must document their achievements and post them using the Bb discussion board, where teacher gives feedback. When the ten sessions are completed conclusions and final results are posted.

Finally the teachers have to evaluate the complete teams performance, if the requirements are fulfilled students are approved and they get their needed credits.

2.2. Places and transitions definition

Places are the steps to complete the course, there are 16 places and they are:

P1: Closed course
P2: Open course
P3: Log in
P4: Tutorial A
P5: Tutorial B
P6: Project scheme A
P7: Project scheme B
P8: Practice session A
P9: Practice session B
P10: Documentation A
P11: Documentation B
P12: Partial goals A
P13: Partial goals B
P14: Consultancy session
P15: Course evaluation
P16: Credit for next course

Transitions are the action or events that must happen to let the model evolve. There are 27 transitions and they are:

T1: Course registration
T2: Password entering
T3: Project selection
T4: test A approvement
T5: test B approvement
3. IMPLEMENTATION

The implementation is done using the Blackboard platform under the project oriented learning approach. The students can enter using a web browser to the blackboard Virtual Laboratory Project section.

Once there the students check the course assignments, they will find the project to develop, the teams to work with, and the basic instructions of the course.

Besides, they will find the course documents, the external links, the virtual classroom and the discussion board among other tools, see figure 5.

2.3. Petri net graph

It’s a graphic representation of places, transitions and a set of arcs that indicate the flow of the model. In this case the figure 4 shows our Petri net graph.

3.1. Bb classroom

While the students are studying the tutorial course, implementing in practice time or documenting, they can reserve consultancy time with their teacher. This can be done using the Bb classroom. There’s an interactive window where all the users can write, draw or navigate the web at the same time, besides the teams or the professor can show a presentation or chat as shown in figure 6.

Virtual classroom is a synchronous tool, it’s very helpful to have direct communication and to get doubts answered immediately. The author Edward E. Doering considers that classroom feedback constitutes an important diagnostic tool [8].
3.2. Bb discussion Board

Discussion board is an important tool, it’s a group forum to discuss important topics of the course. Since it’s an asynchronous tool can be considered as the most flexible and widely used tool during the course. See figure 7.

![Figure 7. Discussion board.](image)

3.3. Virtual experiment interface

The virtual control panel, the webcam or the chat can be simultaneously accessed from the platform. Figure 8 shows the window organization of the visualization and control windows.

![Figure 8. Virtual experiment interface.](image)

4. RESULTS

The system was tested by on-campus and off-campus users. Students of ITESM Campus Toluca and Fachhochschule Esslingen were able to log-in, learn the course information, get a valid model for the experiment, implement and document their work successfully.

The Virtual Laboratory Project has limitations, since the consultancy and practice time are restricted. Therefore, only the teams with reserved session time are able to use such resources at a time. Other users have to wait for their programmed session to access the equipment or synchronous professor assistance.

5. CONCLUSIONS

The Virtual Laboratory Program is satisfactorily working in the Blackboard platform. The students that worked using the Program Oriented Learning approach are fully satisfied with the results of the program. They were able to work with students of a different country using high technology tools. The final project was a complete integrated project, result of the collaboration and creativity of the international student teams.

The language barrier was eliminated by using English as the bridge language. However, the students were very interested in learning the native languages of the participants, this motivated a fully cultural exchange as a very positive effect.

Finally we have the following benefits

1. Virtual team experimentation based Project Oriented Learning technique.

2. Distributed laboratory facilities for a group of universities that share the same hardware at a lower cost than each university would have to buy the required experimental equipment.

REFERENCES


