COLLABORATIVE LEARNING IN VIRTUAL LABORATORIES

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ABSTRACT
The use of Information and Communication Technologies (ICT) has gained its prominence in the building of educational collaborative environments providing new ways of knowledge acquisition. With the aim of obtaining a system which fits with the educational purposes, it is necessary to join pedagogical and technical efforts.
In this paper we are going to deal with the design and implementation of a platform for supporting collaborative learning in virtual laboratories using tools such as whiteboard, chat, posting tools, modeling experiments, simulation tools and remote laboratories.
Regarding the design of this platform it is has been used J2EE technologies for supporting the asynchronous communication and Elvin notification servers to support the synchronous communication.

KEYWORDS
CSCL, Virtual Laboratories, J2EE, notification server.

1. INTRODUCTION

The use of Information and Communication Technologies (ICT) has gained its prominence in the educational field providing new ways of producing learning.
More concretely, our developments are focused on Computer Supported Collaborative Learning (CSCL) system in which the ground of the knowledge building is the user collaboration. Therefore the use of tools such as whiteboards, posting tools, chat and modeling collaborative tools play a vital role in the learning process.
In this paper we are going to deal with the development of a CSCL educational platform which will be one of the result of the European project COLAB “Collaborative Laboratories for Europe” (IST-2000-25035). What is more this system does not pretend to replace traditional education in fact it is shown as a system used to enrich the learning process encouraging students to learn Physics theories by collaborating using experiments. This environment does not pretend to be a Virtual Campus. On the contrary it will be used to enhance collaborative communication between users of the same group, allowing to store the results of their experiences as well as supporting their interaction in an online session.
This paper is structured as follow. In section 2 we are going to tackle the technical aspects of the development of this platform, the section 3 deals with the collaborative tools introduced in the system and section 4 show the conclusions and future work.
2. COLAB SYSTEM

2.1 Colab Architecture

This environment has been designed to offer different areas in which users can collaborate in order to coordinate the task (Meeting), to consolidate theoretical aspects (Theory room) or to run experiments (Laboratory room). In order to support asynchronous and synchronous communication we have designed the core of the platforms as follow.

With the aim of storing the information in the educational platform (including initial configuration files) the asynchronous part has been developed based on J2EE technology (Java 2 Enterprise Edition) using the JBOSS server in our development. The major benefits of using these technologies are:

- Its three layers design which allows the separation between the graphic interface, business methods and the database. Allow to develop portable code, so it can be run in any platform.
- This technology is based on well-known standards which help in the system configuration and management.

However, the use of this technology is not enough to solve synchronous collaboration between tools and users. Due to its high performance, efficiency and the good results in previous research, it has been selected the Elvin notification server as the core of the synchronous system. So it is responsible for managing the subscription events from tools, groups and theirs location. So the abstraction of a collaborative session will be built over this technology managing the relations between users, groups and collaborative areas.

The JBOSS server stores all the COLAB structure, including the visual tools, which allows the collaboration between users and experiments (simulators and remote laboratories), users information, relations of groups, buildings, floors and rooms, as well as sessions files.

In the figure 1 is shown the general schema of the COLAB architecture. So all clients will establish a connection with the J2EE server in order to be introduced in the COLAB structure as well as another one with the “Elvin Bus” to send and receive events to or from other clients or tools or experiments (sending events to start, stop the running of an experiment or receiving events with the results obtained in the experiment).

![Figure 1. COLAB schema, reflecting the different elements like JBOSS, Elvin server, clients and Phenomena](image)

In order to build a flexible and adaptable tools all of them are configured using XML files.

2.2 Synchronous Communication Features

Dealing with synchronous communication it is necessary to take into account the following features:

- Users in the same session manage the same information (Workspace Awareness)
- All the resources in the system has to be accessed in a coordinate way which implies concurrency policies.
• The user connection in the session will be possible at different points in the time. (Late Coming).
• All the users need to be conscious of the online users in their same session. (Presence Awareness)

To solve the first aspect all client tools are subscribed to receive some events inside a session depending on the kind of tool, so all the users in a session can view the same information.

About the second point, it has been introduced the term of “leader” inside each room, so the first user who enters in a room will be the responsible for directing the activity progress in this room. This role can change in the collaboration, therefore others users can ask for control of the session and the actual leader can give it to anyone of them or well ignore these requests. What is more, when the leader leave a room, there is an automatic leadership transfer to another user in the room.

Furthermore, it is necessary to define a mechanism to establish critical sections which should be executed by only one user in order to obtain a coherent control in the change of some parameters. This mechanism will allow to synchronize the use of some sections and it will be modeled using a Token implementation, represented in our system like an EntityBean with grab and release methods.

As in the traditional education, the collaboration is held with a reduced number of students in the group, so it is unusual to have more than five users in the system. Taking into account this fact and searching the less delay to send the actual status to the late coming users we have solved this issue supporting on the leader. Due to the fact that the leader will be the application with all the status of the collaboration, the leader will be the responsible for sending this information when he notices that a new user has come into the room.

To cover the Presence Awareness feature, the application shows the members list in the left, lighting the online users and showing their location in the session.

3. COLLABORATIVE TOOLS INSIDE THE SYSTEM

One of the basis which help in the collaborative knowledge building are the tools used by the group for sharing the knowledge of each participant. In this way the result from these interactions is the ground for the knowledge building process.

With the purpose of covering the previous aspect it has been implemented a Chat, a Whiteboard, a Process Coordinator which helps users to follow some goals added by teachers or by users in the same group and Model Editor which allows designing simulations introducing different kind of elements and configuring them with values or parameters according to the group decision.

There are others tools which help in the learning process and are the basis for the discussion and the knowledge building of the group, such as simulators visual tools, graph and table tools and html viewer, which give general concept to students for starting to work in the collaborative area.

![Figure 2. Colab application showing a remote laboratories and tables and graph tools with the result of the experiment](image)

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4. CONCLUSIONS AND FUTURE WORK

One of the result of the Colab project obtained at this moment has been this platform for the collaborative learning in the physics theories by using virtual laboratories. As it has been explained before, this platform offers different collaboration areas where users can share their experiences and build new concepts or models by using tools such as whiteboard, chat, process coordinator and model editors. Each collaborative area is designed by teachers according to the learning purpose of this area.

The development of this architecture has been based on application server architecture in which the integration of new tools could be performed easily using packed jars and following the J2EE specifications. In addition to support synchronous communication it has been used notification servers to receive and deliver the events in the system.

With the aim of encouraging students in the use of this platform it has been elaborated a intuitive interface which allow a friendly collaboration in the platform and in each one of the collaborative areas. In this way we pretend to encourage users to learn Physics by the use of this system. In the next months the pedagogical test will be held in different school from different countries.

In addition this system provides a way of catch and save important events from the collaboration in the system, and in this way teachers will be able to trace them.

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REFERENCES


