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# Improving Tutoring Activities Using a Multi-Agents System Architecture

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## 1 PROBLEM AND MOTIVATION

Although Intelligent Tutoring Systems (ITS) have been implemented with relative success they are not practical enough. The restrictions of these systems can be overcome when we attempt to integrate the notion of co-operation to the teaching-learning process. By using a multi-agents focus where the techniques and methods we can work in a co-operative way taking into account external human agents and internal agents modelled in the machine (computer) we can have more chances to improve these limitations.

The system (under construction) is a multi-agent ITS that simulates a lake with plants and different types of fish. These elements are typical of our real world (the river in our city and its surroundings). We intend to use this simulation in order to help raise the consciousness of teachers and students about the problems that pollution can bring to our lives.

Our motivation to build the environment is based on our interest to research alternatives to promote a better interaction between machine (working as a tool to support the teaching-learning process) and the user (student). The design of this interactive environment, with its enjoyable aspects (expressed by the game interface) allows the student to use trial and error activities, test hypotheses and build up his/her knowledge.

## 2 BACKGROUND AND RELATED WORK

The related works are Viccari, Coelho, Correa, and Moussalle (see references). They developed experiments applying agents to ITS environment design in order to understand the process underlying the dynamic interactions between the artificial tutor and the student, using agent's *Mental States*.

In our work the Multi-Agent Systems (MAS) and Mental States are also used to design and implement an ITS which explores the tutoring activity during a section with two students.

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We want to expanded Correa and Moussalle research about the teaching strategies of the tutor and we have built a more complex student model based on Mental States. Another difference is the number of agents in our system: we worked with three and they had two.

Our system is a more complex solving problem environment than the others refereed above. We had to model a complex situation and create a heavy simulation to give the student possibilities to test hypotheses about their knowledge to solve the given problem using the available tools.

To better understand our work is necessary knowledge about ITS, pedagogical agents, and Mental States.

## 3 APPROACH AND UNIQUENESS

The conception of the system was based on reactive agents (scenario elements) that represent the different ways to obtain the solution to a problem and cognitive agents (the tutoring agent, the ecologist, and students represented by characters) that monitor the environment and try to solve the problem. We use a DAI architecture (Distributed Artificial Intelligence) referential subarea in our application. Our system is composed by a society of agents who work co-operatively to achieve a common goal: to fight against the pollution resulting from foreign elements (pollutants) and maintaining the equilibrium.

We designed the system to be played by two students using different machines or not. They can be on the same physical place or not. The first student chooses a character to play using four options: Mother Nature, Mayor, Citizen, and Tourist. After that, the second student can choose one of the remains characters. So, the system defined the game configuration (foreign elements that will cause pollution) by a sorting process using random function.

The students can first see a lake in equilibrium, which soon begins to show the action of the polluters. Their challenge is to maintain the equilibrium and fight the action of these foreign elements for a period of time previous defines by the teacher or the user.

There is a visual gauge (a sort of ecological thermometer) to help the user observe the conditions of the lake. A balanced situation is shown when the gauge is full and green. As the equilibrium is lost, the colour changes gradually to yellow, finally changing to red when a dangerous situation is reached, and an alarm goes off. Fish, plants, and microorganisms follow a reproductive model, which allows reproduction when the equilibrium is effective. Reproduction stops with the effect of the pollutants.

The ecologist (tutor) will help the students to combine strategies to maintain the equilibrium in the environment. However, the Ecologist behaviour will be different according to each student traced by his or her mental states.

The interface is under construction and we are running some tests with students to improve it, but it will follow the design presented bellow.

The Ecologist will present messages for the students through a window that appears when the Ecologist sends a message for the students and it will be overlap the game section on screen. And it disappears after 10 seconds.

The Mental States button has the description about the current mental states of the students and the help button presents information about the environment elements.

The cognitive agents are goal-based agents, which pursue the maintenance of the ecological equilibrium as their goal. The cognitive agents (students and Ecologist) cannot predict what the other's strategy will be. The students must work in co-operation, observing the actions that have already been taken and their results, taking either another action within the same strategy or a different one. This occurs alternately. The students can exchange messages to combine actions or build a strategy to fight against the pollution.

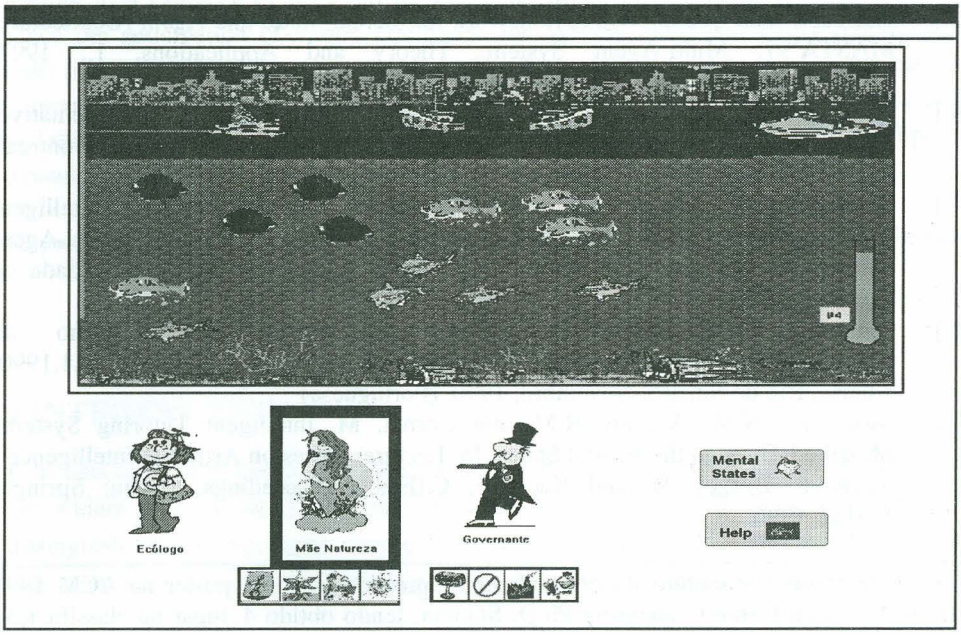


**Figure 1** - The interface

## 4 RESULTS AND CONTRIBUTIONS

Currently, the system is being implementing and we have just part of our ideas implemented and another's still remains to better defined. We intend developing a methodology for selecting a better teaching strategy (selected in a pre-defined set) based on mental states of the agents involved in interaction. Also, we want to find a answer for these crucial open questions: which are the basic Mental states necessary to model cognitive agents on ITS? Is there a specific set of them or not?

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