Virtual Learning Environments Designed in Brazil

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In any pedagogical project, *design* is the kernel of the instructional materials, since it gauges how the learning sessions should be planned. Indeed, it is in the design outline that the features of interaction, of student control, and of evaluation are decided (El-Tigi & Branch, 1997).

When developing computerized pedagogic materials, the most common errors to be avoided are decisions made by the designer who plans the learning activities. Computers, for instance, provide means for higher-level instruction, such as problem-solving, and for increased learner control, but they can also be used for mundane drill and practice. The medium does not dictate the design (Starr, 1997). That is the reason why it is understood that the quality of pedagogical resources currently available on the Internet is quite variable, ranging from excellent to extremely poor (El-Tigi & Branch, 1997).

Various sources of knowledge are likely to guide design decisions. In developing the project described in this article, we have grounded it on the insights of Jean Piaget's ideas on psychology and on Paulo Freire's reflections on teaching (Eichler, 1999).

Concerning Piaget's theories, we think that the basic elements for an effective learning experience are *activity* and *discovery*. Moreover, these activities are meaningful to the learner when they are linked to his or her personal interests, needs, and objectives. It happens because people want to learn in a realistic context; they want to be able to use what they already know to critically evaluate new knowledge and skills that they encounter. These themes are not new, as they have been broadly developed by psychologists such as Jerome Bruner and John Dewey, as well as by Piaget.

As far as Paulo Freire (1996) is concerned, we point to his central importance as a fundamental educational thinker and philosopher, who stands as one of the most important educators of our era. We believe that Freire's work can be reconceptualized in the context of modern debates on information technologies and learning (McLaren & Leonard, 1993).

When conceiving of a virtual learning environment (VLE) inspired by these insights, we intended it to be open to different forms of use, so as to allow teachers and students to decide on the best ways of using it. In the next section, we exemplify some of our VLE characteristics.

The Design of Energos*

We have been developing pedagogic computational materials to present social and environmental impacts of electrical energy production. Simulation and problem-solving activities have been designed to allow students, for instance, (1) to identify the causes and consequences of problems; (2) to suggest possible solutions; (3) to decide which emergency procedures should be taken by studying suitable legislation; (4) to study and analyze measures that would avoid possible negative impacts; and (5) to choose appropriate means of energy production to meet increases in consumer demand.

The investigation into energy issues in our designated system is carried out through the analysis of *Energos*'s electrical system. Data used to simulate the energy matrix were adapted from official sources, such as the Brazilian Institute of Geography and Statistics and the Brazilian Central Stations for Electrical Energy. The matrix provides information such as electric energy production configuration, distribution, and utilization, as well as demand based on socioeconomic characteristics. Our purpose is to use this matrix to promote debates on alternative energy sources within teaching and learning activities. Thematic maps of geographical relief, hydrography, and politics and population density of the *Energos* fictitious micro-regions are used as a support for these activities. A character presents the following problem to the students:

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*The designs described here have been implemented in Java under the concept of free software. We suggest a visit to our home page, so that you can follow the development of the project: www.iq.ufrgs.br/aeq/

...Energos's electric energy consumption has been increasing. In this manner, we think that within four or five years the electric energy production in the region won't be enough to supply the demand. Your task is to analyze the electrical system of this region and to suggest a solution, keeping in mind the need to increase production.

The electrical system of *Energos* is presented as a set of countable boxes whose task is to show the flow and amount of energy a certain region produced, distributed, and consumed in a specific period of time. This simulated system is based on a didactic transposition, and the main variables involved are available (Januzzi & Swisher, 1997). We believe the study of this system would make possible the discussion of economic, political, and social themes, such as alternative electric energy sources (solar, wind, and biomass energy) (Marschoff, 1992). Because of this, some activities that deal with such energy sources were also developed. In the student work, for example, on wind energy, a wind potential pattern for *Energos* was elaborated. Among the activities presented is the description of the factors that influence wind potential, such as wind origin and its characteristics as well as the possibility of its utilization. The electrical energy measuring and transforming equipment was also described. It is possible to evidence the existing relation between wind speed and topography in thematic maps. Therefore, one can realize that the *Energos*'s wind potential is higher on the coast and decreases as it goes to the countryside or comes across topographical barriers.

Figure 1 is a map of *Energos*'s microregions. activities deal with environmental problems concerning the traditional ways of electric energy production—carboelectric, thermonuclear, and hydroelectric. These activities are supported by maps that are independent, although they keep some relationships.

The first pedagogic activities of our project were developed in a fictitious city named Carbopolis, which resulted in software by this name (Eichler & Del Pino, 2000). Farming and cattle raising production are decreasing. The user's objective is to identify the causes of these decreases and to suggest solutions. The students are likely to find out that the problem has been caused by acid rain provoked by the burning of poor-quality coal in the electric power station of the region.

Students must verify the damage and its origins, as well as suggest possible solutions. There are some tools at the students' service that make them aware of what is going on in the region They can, for instance, consult the testimony of farmers, power station public relations people, and miners, or read speeches by mayors. They can also find some available instruments for sampling and analysis of rainwater and air quality, as well as hypertexts to several sorts of consultations.

The students may formulate hypotheses and suggest solutions in order to solve the problem proposed; in other words, they may install available antipollution equipment. In this manner, the students can find out if their hypotheses are in fact the real causes of the problem. They can also re-collect and analyze samples and detect improvement or worsening in rainwater and air quality.

The issues related to nuclear energy production are presented in *Atom City*, which is the town that corresponds to number 52 on the map of Energos. The scenario of that activity is described in Figure 2. The following problem is presented to the students: *There was a delay in the thermonuclear power station annual inspection, and one suspects that there is a leak.* In this manner, the students are supposed to discover if there was contamination or not; in case there was, they may evaluate the level of contamination suffered by the power station or environment provoked by a leak, either of fuel or one of its fission products. The students may do certain activities that would be useful in their investigation, such as: collect samples of air and water and send them to the laboratory for analysis; interview the inhabitants of the city.

Another example of a VLE activity was also developed in *Carbopolis* to emphasize that the modular character of these scenarios goes beyond the thematics related to the debate on means of electrical energy production. The content of such activities is based on an environmental impact problem caused, in this example, by the inadequate application of agrotoxic materials in a soybean plantation. This fact provoked the lowering of quality of water in the river, which is near the bay where the local fishermen live.

To solve the problem, the students can: do a biopsy on fish and identify the reason for their demise; collect samples of water and sediments; localize the river pollutant source; interview the local inhabitants; and create a simulation in a tank of fish and consult a library presenting hypertext routines that support and complement the contents previously approached.

Conclusion

With the development and availability—to be distributed and used freely—of such virtual environments, we intend to contribute to the strategies of information directed to the awareness of environmental emergencies and the alternatives to their solution. □

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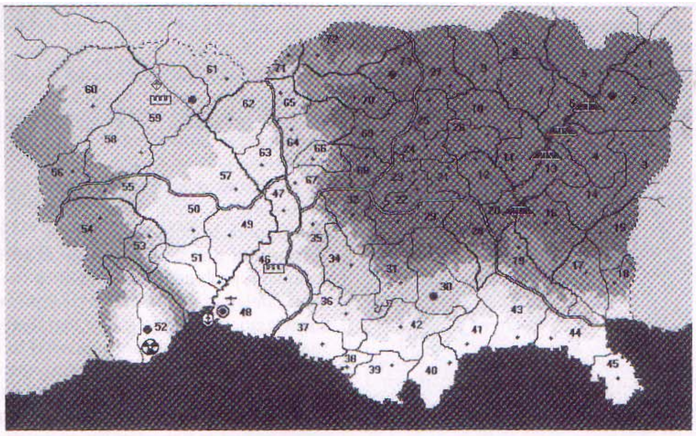

Figure 1. Map of Energos's microregions.

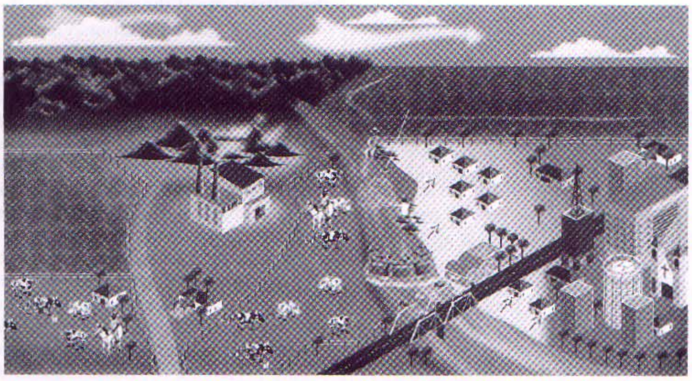

Figure 2. Scenario of activity on environmental impact (acid rain) of a carboelectric power station.

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