Storm as a Model for Measuring Understanding of Electrical Field

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Abstract: This work forms a part of an investigation project whose main objective is to understand the impact that the use of Information and Communication Technology has on the teaching and learning processes. Work has been done particularly on implementing a teaching proposal which includes the use of new technologies for comprehensive learning to advanced level students. We propose to analyze the use of technological resources such as a simulator as part of specific teaching strategies in actual settings and the impact that they cause in the understanding of the concepts of physics. With this work we try to demonstrate that, with the utilization of a storm simulator, the students of physics improve their learning process, on one hand they understand this physic phenomenon and on the other hand, assimilate better the concepts related to Electrostatics.

1 INTRODUCTION

Numerous studies ('Cell phone video recording feature as a language learning tool' by Mr. Nicolas A. Gromik, Qatar University) realized with students in Secondary Obligatory Education and in diverse careers demonstrate a change of attitude towards some subjects with the utilization of ICT (computer, scientific cinema, audio-visual tools); and an improvement in the learning of these subjects. Analyzing the results obtained in these studies, it is possible to verify that statistically significant differences are obtained in the average performance of the students, between the groups of pupils with whom there is implemented a strategy of education that uses technological IT resources and another group, in which a boarding is realized from the traditional education (Wenning, 2005), (Alanís, 2000).

With this work we try to demonstrate that, with the utilization of a storm simulator, the students of physics improve their learning process, on one hand they understand this physic phenomenon and on the other hand, assimilate better the concepts related to Electrostatics (Rosado, 2001); (Palomo, 2006).These concepts are difficult to reproduce in class and in a real laboratory. To cover this necessity the solution adopted by some education centers, especially universities is the use of laboratories in which students complete their formation and do investigation work which can improve or optimize the existing implantations. These laboratories, virtual laboratories are called simulators.

Recently, virtual laboratories have been attracting much attention as one of simulating method for not only various social and economic phenomena but also science researches (Nobuhide, 2001).

The mean objetives of this is:

Understanding the impact of the use of the new technologies in the processes of the teaching and learning of the students in the subject of physics.

Other secondary objectives that can be achieved are:

- Development of students' high-level computer skills and competence (student expertise) in information and communication technology and in physics
- Analyze the use of specific technological recourses as part of strategy in teaching that tries to help comprehensive learning.
- Determine if the use of external representation (images, animations, simulations and actual experiences) help to understand the concepts of physics.

The following analysis, which is done in section 2, from our experience, intends to demonstrate how the use of determined technical resources in a didactic unit, "Electrical Field", helps to improve the understanding of disciplinary concepts. Especially, in section 3 demonstrates the influence of external representations (images, animations, simulations)

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used to register analyze and explain the phenomena of Electrical Field, which are intended to improve the concepts of electrical load, electrical potential, thunder, lightning and beam. Finally, section 4 includes the results with an analysis and conclusions in section 5.

2 THE SYSTEM

This experience has the objective of understanding of the impact of the use of the new technologies in the processes of the teaching and learning of the students in the subject of physics.

This experience tries to:

- Analyze the use of determined technological recourses as part of strategy in teaching that tries to help comprehensive learning.
- To determine if the use of external representation (images, animations, simulations and actual experiences) help to understand the concepts of physics.

Physics is considered by the majority of students and people in general as a difficult and abstract science. What contributes to this concept is the complexity of physics itself the use of a scientific and mathematic language with unfamiliar terminology and the latch of interest of the students caused by the disconnection between physics as studied in the classroom and the phenomena which we observe outside it.

Virtual physics laboratories (applets, simulator, virtual reality, cinema …) try to serve the resources that new computer technologies and Communication offer and to start an interest in the student in a passionate science which is nevertheless considered traditionally difficult for the student (Cabera et al., 2000). The physics laboratory does not just only give the students an important number of self assessment questionnaires and activities to be performed with the use of applets, but also incorporates the tool generator so that the said questionnaires are made on line by the teachers themselves.

When the students are asked about this science they say it is an interesting subject but very difficult because there are lots of physics phenomena they can not observe in their life and they can not imagine these phenomena, so they don't learn important concepts (Perez, 2005).

In this work we centre on exposing a methodology that facilitates to the pupil the follow-up of the didactic chosen unit. Let's sense beforehand our experience in the incorporation of the Technologies of the Information and the Communication (ICT) as supports to the teaching of our matter in order which the pupils could acquire the knowledge of suitable form. With the utilization of these tools the students can be acquiring the knowledge following their own pace of learning, so that departing from very different levels it is possible to come to the final claimed level.

Figure 1: Electrical storm simulator.

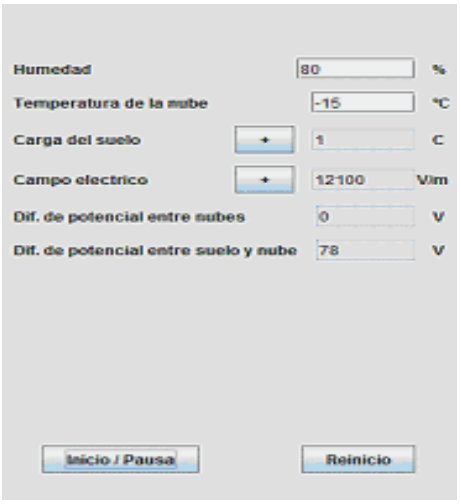

Figure 2: Storm description.

This java applet is a storm simulator where we can development all the important concepts about Electrostatics (Electrical loads, potential difference, electrical field, Law of Coulomb and electrization of the matter).

The pupils can modify the dampness and temperature up to achieving that the cloud is loaded

electrically. When the potential difference between the cloud and land overcomes the electrical field allowed of the air an electrical discharge is produced followed by beams and thunders.

3 THE EXPERIMENT

The mean objective of this project is to show that the use of a simulator helps to improve the understanding of the disciplinary concepts in the subject of physics. In a classroom or in a real laboratory, teachers can not reproduce some important physics phenomena, but with virtual laboratory (in this case, applets) they can.

The goal of this project is to show that the use of a simulator of Electrical Storm (it has been developed by the authors of this article) helps to improve the understanding of the disciplinary concepts in the subject of physics in a group of students in the third year in a teachers training college.

This developed didactic unit was chosen because they were made up of within physics. However in general a deep understanding about the same was not reached. Principal concepts are shown in the following image:

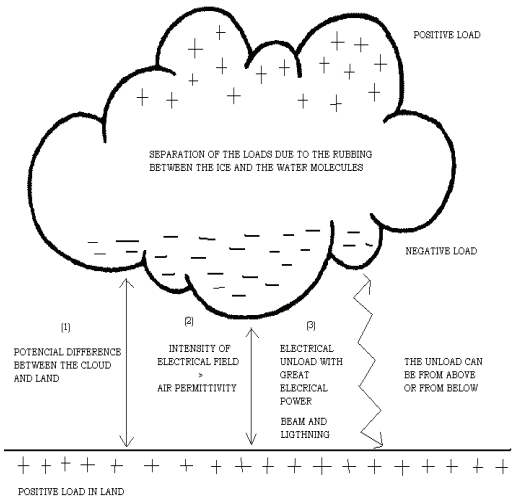

Figure 3: Developed concepts with the simulator.

The numbers of students who took part in the experience were 20, the total number of students enrolled in this subject. 18 students had never studied physics and 12 of them hadn't studied mathematics for several years. And their age was between 20 and 40 years old. These items made explanations were slower and the teacher had to explain the didactic unit deeper.

The tests for the didactic units "Electrical Field" were carried out at the beginning of the first term. At the beginning, students were asked to take a written test of 10 questions, so the teacher could know the knowledge of them about these concepts. The theme was expanded for two weeks through magisterial classes and the students were asked to take a written test of 10 questions again. During the following week the simulator of electrical storm was used where students could do another test. After this another test of 10 questions is planned to see if the objective has been reached.

This way it was possible to compare the results from the two previous texts done by students to check them with the use of the virtual laboratory.

But this isn't the end of the experiment. Two months later, student did again a test of 10 questions with the principal concepts about "Electric Field". We could observe students hadn't forgotten many things.

4 THE RESULTS

The results obtained by students in the third year of the teachers training collage in the 3 steps of the investigation are:

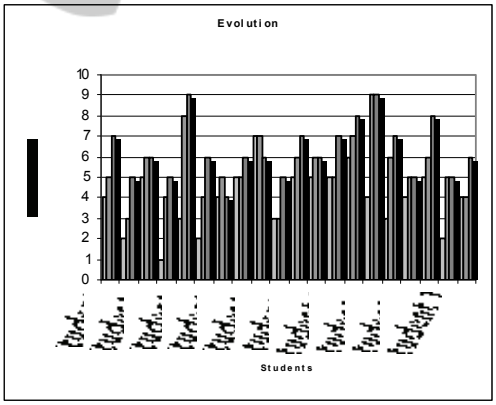

Figure 4: Results after each questionnaire.

This graphics shows how the students improved their knowledge about electric concepts. In fact, they got better results after using the simulator than after the class. There are 4 pupils didn't improve with the applets and only 2 students had worse results with the simulator than with the magisterial class.

Two months later we wanted to know if the students could remember the most important electric concepts.

As we can observe in the figure 5, two months later, 75% of the students obtained punctuation

equal or higher than 5; this means that visualteaching gets good results.

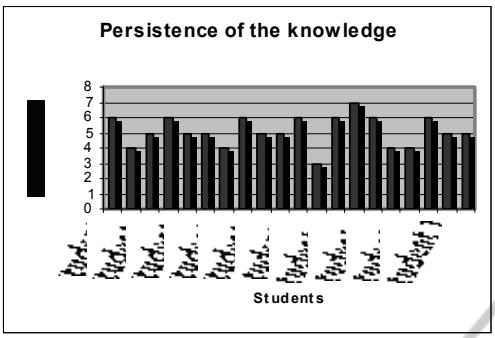

Figure 5: Results after 2 months.

We wanted to know if the using of ITC could improve their interest about the science. The students not only answered tests about important concepts, but also about their attitude towards this science. They were asked to answer 2 questionnaires, before the investigation and after.

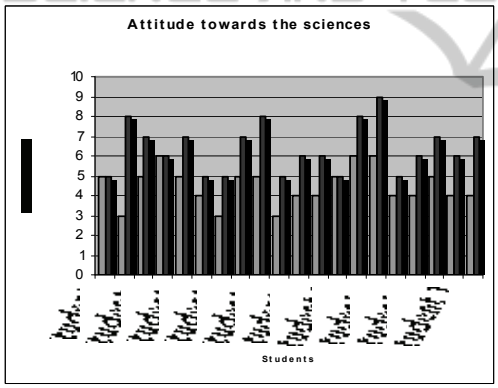

Figure 6: Results after 2 months.

These graphic shows students don't like very much studying physics, in fact, they weren't interested in it but, after using ICT, their interest towards physics changed.

5 CONCLUSIONS

By analyzing the data of the completed experiences, significant statistical achievements in the performance of the students that took part in the experimental group are observed. An appreciable impact in the use of ICT for the understanding of the different didactic units is shown.

This work has permitted us to know the impact that the use of new technologies has in the process of teaching and learning. It is observed that the application of technological resources to represent physical phenomena in actual settings contribute to improve comprehensive learning of the concepts of physics in the students. Development of students' high-level computer skills and competence (student expertise) in information and communication technology and in physics has improved.

We believe that these positive results are due to the pupils can see and handle a physical phenomenon that the teachers can't reproduce neither in class nor in a real laboratory. In such way they don't have to imagine the process. It is not a question of replacing the magisterial classes with ICT, but to completing them when it is possible.

In turn, the results show that, the use of a visual methodology helps to fix and support for a long time the learned knowledge.

The experience in the study provides the setting for the aspects of pedagogic didactics that lay the foundation of educational practices whose teaching strategies include the use of the TICS to impart comprehensive learning that contribute to the formation of the students.

It is not a question of replacing the figure of the professor neither in the classroom nor the magisterial classes. With TICS we want that the students not only learn the obligatory concepts in class but also like the science and the investigation.

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