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SATELLITE TECHNOLOGY AS PART OF HIGH SCHOOL SYLLABUS: AN INNOVATIVE EDUCATIONAL PROPOSAL

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ABSTRACT:

Nowadays universities are being challenged by new social issues. One of the most significant issues in developing countries is to become part of the community and the educational system as well.
Research in the technological field is focusing young people's attention very much. The inclusion of special satellite development with direct access to space operations in the classroom environment will allow students and teachers to enter a basic technological culture that will contribute to their training and simultaneously will contribute to space science.
During this process, the school environment integrates knowledge and develops a change in its approach that requires a strategic interdisciplinary plan to fully profit from a satellite base that is within everybody's reach.
Under these concepts, it is necessary:
- To research and develop new courses to stimulate students' interests towards this new "tool" as a means of improving their training.
- To conceive, construct and qualify low-cost ground stations so they can operate satellites, directly from educational institutions.
- To upgrade the µSat-2 capabilities to be operated from these stations.
Due to the fact that satellite µSat-2 will be finished by the end of 2002, the first stage of the project will be carried out at schools using satellite images and introduction to space technology as main topics, these will be the nucleus of the project which will be introduced in many subjects included in the syllabus.

1. INTRODUCTION

On October 4, 1957 the first earth's artificial satellite was launched, giving birth to what some people called the Space Race and others, the most visionary people, the Space Era. Almost 39 years later, on August 29, 1996, the first Argentine artificial satellite was launched from the Russian Cosmodrome at Plesetsk. This satellite was thought of, designed, built and qualified in Argentina. The first two propulsive steps of the SEMIORKA-MOLNYA rocket that launched VICTOR were the same that impelled the historic flights of SPUTNIK 1 and Yuri GAGARIN. This makes us notice the different speeds by which the biggest technological lines are moving with by the end of this century.
The project, called uSAT, went through the stages that space quality requires, which come from the structure of the scientific method itself: Analysis, Definition, Development and Qualification (Validation) of the concept.
The Know-How achieved through the orbiting of the uSAT 1 and its operation during more than three years, make us think that using our own resources and with the concept of low cost engineering and state of the art technology, **"the development of a uSAT series satellite operational station, to be used by high schools, schools and universities"** is possible.

On the other hand, the educational transformation that has started in Argentina as from the Federal Law of Education ("Ley Federal de Educación"), make educational institutions face new perspectives that model teachers' training for the XXI century.
We want to emphasize some of the most important points for our purpose. Such as the explicit call to a management aimed at the feedback and interaction between university and high school, specially in teacher training. This is a key factor to achieve the desired levels of educational quality centered in student training.

Some other aspects to be outlined are the need to integrate the functions that involve universities: Research, teaching and extra curricular activities, above all. Also their need to influence the development of the community from each one of these functions.
The continuous updating of contents, the need to satisfy people having higher educational needs, interdisciplinary work, permanent teacher training, and constant evaluation of educational practices requires new proposals.

Also advances in the teaching of Sciences and Technology set schools in the need to significantly change methods, organisation and structure and their concept relations, which implies a change in the disciplinary and pedagogical didactical fields.
Here Science, Technology and Society (STS) acts on the dynamic interaction between Science and Technology and their effects on environment and society. It thinks about the influence of social, political and cultural aspects on Science and Technology and measures the impact of Technology and Scientific ideas on people's lives.
Likewise, the education of scientifically trained people demands the teaching of an updated science. This means providing a functional scientific-technologic culture, with practical applications to every day life.

This is why the adding of new technologies in the school and familiarity with the processes related with access, processing and communication of information will allow them to be recognised as a means to explore different phenomena of reality.

In this context, the micro-satellite as a product in itself and the μSat-Edu station for its operation that exist in high schools, facilitate the access to satellite technology in teaching and learning contexts and environments that motivate teachers and students who are committed to the production and use of knowledge.

In this project we recognise a priori the following contributions of university education to other educational levels:

- To offer new technological resources for elementary education.
- To contribute in the improvement of technological training for teachers.
- To tighten the bonds among other levels of the educational system, and academic and research environments of our country.
- To contribute in the improvement of the learning quality of young people.
- To encourage the use and handling of technologies in daily situations, and the solution of problems.

2. THE uSAT-EDU PROJECT

It is directed to all high school public or private institutions.
Inserted at the management and teaching levels and applied to all the responsible for the educational process: superintendents, teachers, students and parents.
We wish to emphasize its adequacy and possibility according to the argentine educational and socio-economic situation.

- Low cost.
- In situ direct access to satellite technology.
- Teacher-student access to places, tools and methodology which are part of the satellite technological environment and which today is the development axis for our countries.
- Teacher training in technological and research areas with direct classroom transfer to better learning of highly motivated students.
- Building a bridge between University and educational system aiming to transfer knowledge to the social educational community

μSat-Edu project works at two levels of Educational Institutions.

a) Institutional
b) Teaching-Learning

2.1 Institutional

It is from the institutional management that the integration of said project to the I.E.P. (Institutional Educational Project) will be made.
The installation of the μSat-Edu ground station will be performed together with the facility and equipment updating.
A co-ordinating committee will be established. It will be responsible for the planning, starting and evaluation of the project and will be integrated by people from different institutional and professional levels of the μSat.
This committee will be trained according to a general program and will receive the required knowledge and procedures to operate said stations.

2.2 Teaching-Learning

- Design and implementation of an interdisciplinary program for teacher training that takes into account conceptual, procedural and methodological concepts that make reference to:

  - μSat micro-satellite series: Design, functioning and potential as a source of information, etc.

  - μSat-Edu Stations for the operation of satellites:
    - Description, how to operate them, application potential, etc.
    - Methodological applications to the curricula: Learning activities designed for different subjects in the project: Physics, Geography, Technology, etc.
    - Interdisciplinary and extracurricular applications: For example, school newspaper, mini research projects made by students of the ***"polimodal"*** system, projects to be performed within the community, etc.

  - Forming of groups of teachers and students to begin research and to apply satellite technology guided by specialist in Space activities.

  - Development of areas for the presentation and debate of production and experience at the inter-institutional, provincial and/or national level, by using new information and communication technologies, mainly Internet and its interactive services.

A program will be elaborated, from this experience and its corresponding evaluation. It will be done for the insertion and definitive integration of satellite technology with the educational institutional project of the curricula of high schools. μSat-Edu researchers will permanently update this project.

3. SPACE SEGMENT AND GROUND STATION

3.1. Space Segment

Upgrading the μSat-2 capabilities to be operated from ground stations installed at different high schools. (The μSat-2 is scheduled to be launched after the third quarter of 2002).
Mainly the μSat-2 will have an extra set of commands that will allow its operation from the low-cost ground stations

3.2. Ground Segment

The equipment couples ideally with the emerging utilisation of new technologies in High Schools.
Never before have secondary schools been able to post-process raw satellite data, and now they can do it in real time.
This is credited to advances in technology that have recently made the necessary equipment simple, inexpensive, powerful and available enough for any school to fit into their technology-educational curricula.
The μSat-Edu ground station will be able to:
- Follow the satellite in its orbit through software that permits the satellite's simulation in orbit and thus its position in relation to the ground station. (Figure 1 and 2)

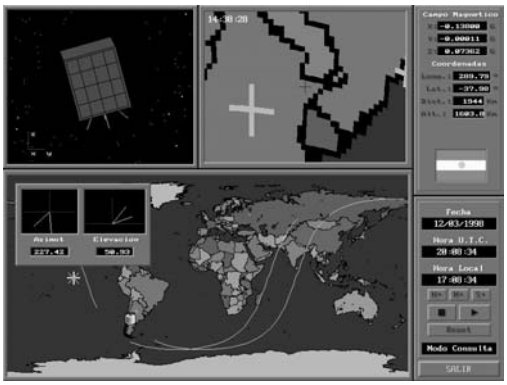

Figure1: Simulation Software - Orbits

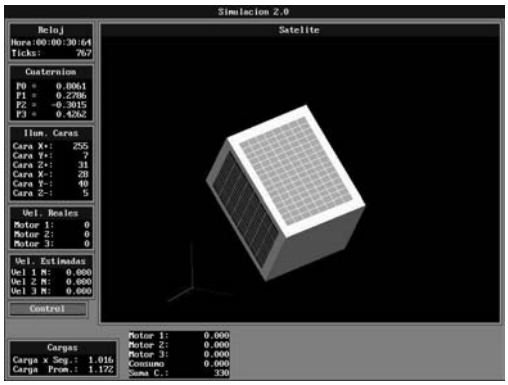

Figure2: Simulation Software - Satellite Alignment

- Follow the satellite in its orbit, through a "pointed at" system that permits the receiving/transmitting antenna's orientation
- Make connections via UHF in a bi-directional way.
- Send commands to the µSat-2 (Figure 3) like:
  - Storing information (data) in the satellite's memory.
  - Making a request for the status of the satellite.
  - Reading on board appliances:
    - Solar sensor
    - Magnetometer
    - Horizon's sensor
  - Making a request for future readings, that are to be collected later.
  - Asking for "Satellite Time", for ground operation.
  - Making a request for the orbit's Keplerian Data.
  - Asking for temperature on board.
  - Consumed energy and battery status.
  - Image reception of satellites shots.
  - Stored information reception (messages, letters, etc.)
  - Sensing meteorological ground station data (temperature, rain, received energy, etc.)
  - Printing of Data and received images
  - Software for pre-processing the received images.

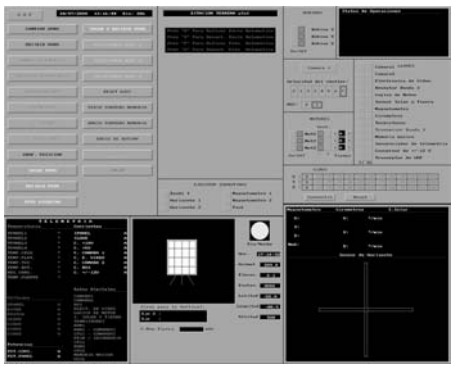

Figure 3: Monitor Screen showing Commands and Satellite Status.

4. CONCLUSIONS

We must highlight its feasibility and adequacy to the educational and socioeconomic argentine context.

- Low cost.
- Direct (in situ) access to satellite technology.
- The integration of teachers and students to spaces, tools and methodologies specific for satellite technological environment that are the basis for the people of this millennium.
- Teacher training in technological and research areas aimed at direct transference into the classroom in order to better the learning of highly motivated students.
- Creation of a link between university and educational systems, generating the transference of knowledge to the educational- social community.

Similar systems are partially used in some countries, in the United States there are technology – education programs. Our solution differs in two ways:
a) This system is the only one that has a satellite (with special features designed for this purpose) that can be operated directly from schools.
b) The systems not only promote space activities, they are also used to motivate other subjects of the school's curricula.
The learning potential is enormous. Students get marketable technology skills in the areas of electronic access of information, post processing of raw satellite image data, multimedia production, and both electronic and verbal communication skills, while performing really important school science projects.

The **"Direct Experience"** helps to prepare children for participation in an increasingly technological world

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