INPE-524-RI/225
SACI Project

BRAZILIAN PROJECT

The Royal Society
A meeting for discussions
The Introduction of Satellite into
Educational Systems
London, 18-19 September 1974

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September, 1974

c.c.: 60

THE INTRODUCTION OF SATELLITES INTO EDUCATION SYSTEMS: BRAZILIAN PROJECT

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ABSTRACT

In this paper we will describe the feasibility study for the use of some channels of a Brazilian domestic communication satellite in education. The study started in 1967 including software and hardware aspects of the problem. To test some of the working hypothesis a pilot project was established in a state of the Brazilian Northeast, where since late 1972 we have been training over a thousand teacher and many thousand primary level students in 500 schools. One television VHF station with two repeaters and three radio stations have been used. In the second semester of 1974 we will use the NASA-ATS-6 satellite to test the space segment of the project in the same schools. The objectives of the mentioned pilot project are. (a) to test the efficiency of an educational programming using TV, radio and printed instructional materials; (b) to develop techniques for the production of TV and radio programs for different areas and grade levels; (c) to improve conditions to better meet the needs of the clientele based on the results of formative evaluation; (d) to offer better educational opportunities to a considerable portion of the school population in the area of the experiment; (e) to develop and test methods for the installation, operation and maintenance of ground equipment; (f) to test the utilization of communication satellite as an element for distributing modern education.

1. INTRODUCTION

We have no doubts that space application programs can highly contribute to national development of many countries. In the particular case of Brazil a number of such programs where defined by 1967 to be implemented by its space agency - INPE - Instituto de Pesquisas Espaciais. Among such programs one was designated Project SACI, with the scope to study the feasibility of the use of communication satellites in education.

Many topics were taken into consideration, namely:

- decreasing costs of satellite communications;
- available technological alternatives;
- present and future expenditures in the educational sector;
- number of children in the 7 to 14 years of age were out of schools;
- problems associated with education in the interior of the country;
- constitutional determination concerning the State obligations to provide educational opportunity to all Brazilians;
- benefit/cost ratios of the options and alternatives, etc.

After considering these and other items a decision was reached to structure the project into several interrelated segments, each one subdivided into phases such as planning, design, production, pre-

operation, evaluations, etc.

The initial segment took the form of a pilot experiment to be performed in the Brazilian Northeast (State of Rio Grande do Norte) including the participation of 500 elementary schools with nearly 1600 teachers and 14000 students. The experiment would use, regular VHF television transmissions and radio, printed materials, and later on the NASA-ATS-6 satellite would use in the same schools.

Simultaneously a study would be made concerning a domestic communication satellite with the additional capability of high power transponders which could be used for follow up of the experiment.

In order to perform these tasks we had to begin by increasing and by training the INPE staff. Naturally we had to use a global approach to the problem since the experiment could not be developed from the engineering point of view alone. There were practically no adequately qualified personnel to produce educational programs in Brazil. In synthesis two interconnected groups were established - one of engineers to think in terms of number of channels, frequency, equipment, maintenance cost, etc., and the other would deal with the formulation of programming content.

2. OBJECTIVES OF THE EXPERIMENT

In this section we want to list the present objectives of the experiment with brief descriptions. These objectives have suffered only minor modifications since 1968, and they will allow one to judge the complexibility of the endevor. They are:

- To test the utilization of the artifitial satellite as an element for distributing a modern system of education. This objective will receive particular operational emphasis starting in October 1974 since Brazil has the opportunity to utilize daily the NASA-ATS-6 satellite until May 1975. Two television links will be tested:
  a) transmissions from INPE at São José dos Campos to ATS-6 to receiver-retransmitter located at Natal, Santana and Mossoró. From these three stations the programs will reach the schools in the area of the experiment. The three VHF-TV stations established by INPE have been in operation (teachers and students training) since 1972 as will be described later.
  b) direct reception from the satellite in 10 experimental schools, using special receivers made in Brazil, Holland and USA, for intercomparison.

- To test the efficieny of an educational program using TV, radio and printed instructional materials. General and specific educational objectives have been established for each course transmitted. Pre-tests,

intermediate tests, and post-tests are used to measure the learning gain. These gains will be compared with the gains of similar but conventional courses. However, it is not the object of the project to test the efficiency of any one new resource in isolation, but rather to test the use of a combination of modern resources in an experimental learning system.

- To develop techniques for the production of TV and radio programs for different subject areas, and grade levels. Inter-disciplinary teams, including educators, communicators, sociologists, and psychologists, were formed to develop and produce modularized TV and radio programs and printed materials. Data obtained through research carried out in Rio Grande do Norte by these teams in 1973, regarding the needs and attitudes of the students and teachers, have permit a more precise selection of educational criteria for program development for this year. Information obtained through highly controlled formative evaluation techniques has made it possible to regulate the presentation of educational material in accordance with the learning capacities of the students involved in the experiment.

- To improve or create conditions to better meet the need of the clientele in Rio Grande do Norte, based on the results of formative evaluation. Two aspects are considered:

a) through a preliminary technical evaluation, which is called Quality

Control, a minimum set of criteria are applied before, during and after the final production of programs and materials in order to introduce improvements before distribution.

b) the basic operations of educational evaluation are carried out by a new team formed in March, 1974, in Rio Grande do Norte, composed of educators from INPE/São José dos Campos, INPE/Natal, the Education Secretariate of Rio Grande do Norte (SEEC), and the Ministry of Education in a near future.

- To verify the level of acceptance of use of new technologies in the formal school system. Measurement of acceptance includes the following clientele: school personnel, primary school students, parents and community leaders. Intensive research on attitudes expectations, and behavioral changes in Rio Grande do Norte by an interdisciplinary team are furnishing us with data in this area. The methods used include direct observation, questionnaires, and the measurement of various indices of social change.

- To test techniques to obtain support from the community for the carrying out of the experiment. Research is being carried out to develop better approaches to obtain greater community involvement and support. The expected end result of this strategy is to implant the SACI experiment in the state system of Rio Grande do Norte, and to provide local personnel with the opportunity to acquire "know-how" in all technical areas of the project. Eearly SACI studies of existing conditions prior to the start-up of the project will be up-dated in 1974 and 1975.

- To offer better educational opportunities to a considerable portion of the school population in the areain view of the cost of the experiment. An educational technology system has been introduced in Rio Grande do Norte, an economically and socially depressed area. However, this objective can only be considered attained after the experimental phase is completed, when we can observe the system functioning efficiently and entirely controlled by the state government and the local communities. Until the introduction of the SACI system, a very small portion of the population received the benefit of good educational conditions.Attainnent of this goal are being measured by the increase in the number of certified teachers and the number of students attending primary school in Rio Grande do Norte.

- To develop and test methods for the installation, operation, and maintenance of ground equipment used in the experiment. A sub-system has been introduced to control the logistic aspects of the project, including the distribution of auxiliary equipment, printed materials, and technical problem-solving on site. Special training courses for all logistic personnel have been provided in 1974, through TV and Seminars.

- To analyse the results of the project in terms of cost/benefits, cost/effectiveness, comparing the data from the experimental system with the conventional one. A team has been formed to quantify "benefit" and "effectiveness" and to develop models to permit the making of inferences

regarding the cost/effectiveness of the project, and also to furnish specific information in this area to other educational planners. This task will receive special attention, since the criteria of cost/effectiveness is central to the viability of the proposed regional and for national extention of the project. In this context, we understand "effectiveness" to mean the degree of educational efficiency in the system, and for "benefit", the combination of final social-economic products resulting from the project.

- To prepare personnel for the planning, control and development of material, evaluation and operation of projects in the area of educational technology. This objective is inherent in our goal of acquiring "know-how". It is a regular function of our everyday activities. However, certain components in the system are specifically organized for the training of personnel. For example, the the initial phases of the experiment, the CEDO courses in Radio and TV given at INPE in the early's 70, INPE seminars on systems analysis, and now the Graduate Program in Educational Technology, started in January 1973. Before December 1974, we will have the first graduating class in our Master's Program, with 21 candidates. In January 1974, a new class of 26 candidates started the two-year work/study program. Additional members of the SACI staff are enrolled in "isolated" graduate or technical courses provided by INPE. In early 1975, SACI will begin technical training of teams in educational materials development, and studio production at INPE/Natal, Rio Grande do Norte for continuation and

expansion of this system under the auspices of the State Government. The benefits from this extensive training of personnel will not only add to the effectiveness of the Project, itself, but also will enable the direct transmission of experience to future programs in educational technology in other regions of Brazil.

3. SATELLITE TECHNOLOGY DELIVERY SYSTEM

a) Demonstration Phase

Due to delays on the launching of NASA-ATS-6 we started the demonstration phase by installing three television stations (channels 2, 5 and 9) and renting timeof three radio broadcast stations in the area of the experiment. These stations were put into operation in late 1972 for teachers training and in March 1973 they began transmission for students in the same schools.

The mentioned television stations will be used to re-transmit the ATS-6 signals originated from INPE in São José dos Campos in the State of São Paulo. In addition 10 small stations for direct reception from the satellite are being installed in schools at varying distances from the ground VHF transmitters. These stations are comprised of a small parabolic antenna (about 2m diameter) for 2.5 GHz, a preamplifier converter and a regular black and white TV monitor. The transmitter for the up link has a 10m diameter parabolic antenna with a kilowatt amplifier.

By late October 1974 we will begin to use this system until 15 December. From this date on the schools will be on vacation until mid February 1975 and the system will be used on several medical

experiments. Transmissions to the school will continue from February through May 1975 when the satellite is supposed to be moved east to the Indian experiment.

We are studying the possibility of modifying the system to use it with the French-German Symphonie satellite after June 1975.

b) Operational Phase

In 1972, the Brazilian Government set up a high level committee, formed by the key personnel of agencies interested and related to the domestic system to analyse the general concepts of a communication satellite system along the lines proposed by our Space Agency.

The above mentioned committee generated a technical report which has been approved by all concerned and is presently awaiting final approval by the President's Office, before any action for execution is taken.

The initial communication satellite system (forseen for 1978 time frame) will have three satellites - one spare on the ground, one spare on limited use in orbit and one active. The high power transponders will operate with down-links on the 2.5 GHz band allocated

for the Broadcasting Satellite Service in WARC. The other transponders will be in the conventional 6 and 4 GHz bands.

The prime satellite will be positioned between 72 and 83 degrees West longitude in geosynchronous orbit. The launch vehicle should be a NASA Thor Delta 3914.

Unique services will be provided by this complementary system, such as thin-route telephony for isolated communities, TV distribution to the Western part of the country, mass media educational programs direct to schools, etc.

The report sums up the advantages of satellite communications for a large country like Brazil, including cost/benefits for long distances, facility for diversity of services, rapid response to unantecipated traffic growth, etc. It concludes that the proposed system is economically feasible.

4. CRITERIA FOR CHOOSING AND DELIMITATING THE AREA OF THE EXPERIMENT

To begin with we needed to choose an area in which we could simulate a micro Brazil, representing an average of the common problems in transportation, communication, education, health, electrical power distribution, etc. The experience to be gained had to be as near reality as possible for the future expansion of the project to larger regions, becoming eventually of national magnitude. We chose the State of Rio Grande do Norte in the Brazilian Northeast. The State Government demonstrated interest from the beginning. We then selected an area of the State containing about 2000 schools out of a total of 3500. The criteria used for selection of this area were:

- Involvement of the largest concentration of municipalities within the area;
- Inclusion of both rural and urban populations in the seacoast, the "agreste" and the "sertão", typical zones of the Northeast;
- Inclusion of the largest number of centers operated by the State Secretariate of Education (SEEC);
- Inclusion of economic poles of development of the State to coincide with the study underway of the establishment of economically viable communities;
- Technical restrictions on the signal coverage of VHF-TV and radio transmittions, etc.:

- Availability of a large number of schools in order to permit us to select a representative sample for experimentation and control.

5. CRITERIA FOR SELECTION OF SCHOOLS

In order to be able to validate and generalize the results, the schools were chosen according to the following criteria:

- All schools had to belong to the public school system, i.e., state or municipal;
- The three existing types of public schools either urban or rural, had to be included: (a) "Grupo Escolar" which is a school with separate classrooms for each class, a teacher for each class, a principal, a secretary, etc.: (b) "Escola Reunida" which is a school with several classrooms and teachers but without admiistrative staff; and (c) "Escola Isolada" which is a farm school with one room and one teacher;
- The three categories of schools would be selected using a random sampling technique; and
- The sample would include more than 25% of the students in the area of the experiment.

Since one of the objectives of the experiment was to test the effectiveness of technologies applied to education, it was also necessary to make a comparative analysis between schools included in the technological system and the ones of the traditional system.

To give an idea of how bad the traditional system is

I would like to present here an important preliminary result of the drop-out rate (evasion) during 1973 for first grade students in the area of the experiment:

School	Drop-out (%)		
	Max.	Min.	Average
Traditional system	44	28	33
Technological system	9	3	6

6. STUDIES OF THE AREA

In order to adapt the proposed technological system to the real needs of the region it is imperative to study in depth many aspects (social, political, economic, geographic, etc.) of the environment. One must obtain the support of the local communities. As already mentioned in the listing of objectives, our research embraces many types of surveys and indicators of acceptance, including characteristics of teachers, students, schools, community leaders, program contents, field support, etc. and the interfaces among them.

To be more especific, the surveys related to teachers, students, schools and local leaders, were performed with the following characteristics in view:

Teacher characteristics - to obtain detailed information on their needs, values, areas of interest, educational background, professional experience and personnal aspirations, involving the 3 categories of elementary teachers existing in the public school system.

Student characteristics - to obtain information on their needs, values, learning difficulties and personnal aspirations.

School characteristics - to obtain information

concerning location, administrative dependence, category, construction type, installations, quantity and quality of permanent school material.

Community leadership - to identify the communities leaders in order to get their support for the experiment, considering that the participation of people and/or community is of vital importance when introducing a technological innovation in the education field.

The characteristics of teachers and students were determined by means of a representative sampling method. The survey of the characteristics of the schools covered the universe of schools involved. The community leaders were identified by a crisscrossing study of the opinions collected in a questionnaire applied to each county.

We have counted on the interest and collaboration of many agencies, mainly the State Secretariate of Education (SEEC) and the Mayors of the municipalities involved in carrying out our research. To show their interest for example, I would like to mention that the State Governor is planning to expand the number of participating schools from the present 500 to over 2500 in 1976 using the existing ground transmitters.

7. EDUCATIONAL PLANNING AND PROGRAMS

The educational planning is carried on by the Educational Materials Development Group of the project at INPE/São José dos Campos, and takes into consideration the recommendations of the State Council of Education and existing federal legislation. It includes planning for each Mission, elaboration of curriculum, study of characteristics of the clientele, definition of the general behavioral objectives of each curriculum area, determination of the central theme of each unit, integration of the activities of each area, establishment of the basic characteristics of the programs, the number of programs for each unit, and directions for studio production.

The actual production of the programs is carried out by the studio Group. At present all TV and radio programs are recorded at INPE/São José dos Campos and copies (video and audio tapes) are sent to Natal by mail pouch until we start to use the satellite transmissions.

INPE has created a program technique for primary school instruction which is used to meet the psychological, educational, and production needs of the clientele in Rio Grande do Norte more effectively.

We call it the modular format. Modules, or program segments, 30 seconds to 3 minutes in duration, form inter-changeable

component parts of complete programs. These modules and interfaces are assembled into 15 minute programs which are prepared to meet specific educational objectives.

The formats most often used are: dramatization, animations, "table-tops", graphics, photographs, and films.

This program design takes into consideration the educational criteria of "Unidades Pedagógicas" in which diverse activities are integrated into a common nucleous of instruction.

Altogether, 855 television programs (classes) have been produced and edited for use in teachers training, first and second grade students.

Radio production also utilizes the modular approach. The average number of modules per program is eight. This technique allows SACI to capitalize on the language most characteristic of modern radio, the jingle, the "spot", short dramatizations, and concise information presentations. The montage of radio modules follows the same educational criteria as the TV programming, including the integration of instructional areas.

So far we have prepared over 800 programs which are used in teachers training, second and third grade students.

8. PROJECT EVALUATION

The evaluation of the experiment is conceptualized as a continuous process made through measurements which permit us to verify if the proposed objectives are being attained. In this sense, evaluation is a tool to improve the project. Besides it is not enough to know if the objectives have been reached but how they have been attained.

This type of global evaluation will try to answer questions such as:

- What possible generalizations can be made about the project?
- Which internal changes of structure result from its implementation?
- Which modifications of the initial plans are taking place due to the realities of the ambient?
- Which recommendations and/or suggestions should be made to other groups carrying on tele-education projects?

In order to put this ideas into an operational framework we make use of three segments, namely:

a) Evaluation of the effects of the implementation of the system, including:
   - Educational (learning, supervision, program format analysis);
   - Psycho-social impacts;
   - Cost/benefits.

b) Evaluation of the processes in the implementation of the system, including:

- Managerial aspects;
- Interfaces between INPE and other agencies;
- Personnel training;
- Social interactions;
- Operational aspect;
- Analysis of the instructional materials.

c) Evaluation of the hardware system (engineering) including maintenance and operation of television and radio sets, satellite receiving stations, signal quality, etc.

9. CONCLUSION

From what has been described in the previous sessions one should be able to have an idea about the proper magnitude of Project SACI. For brevity sake we have not elaborate on concurrent activities such as INPE's Project on Economically Viable Communities, the use of SACI experiment as a laboratory for students of our master's degree program on educational technology, and other segments.

From a very small staff allocated to the Project 1968 we have generated the present group of nearly 200 people fairly knowledgeable in satellite and educational technology at a cost of only four million dollars. Much remains to be done to transform the experiment into a national program. Our present government has just issued the Second National Plan for Development (1975/79) which allocates resources to Education on a priority basis and makes reference to "... keep up-to-date with progress in educational technologies and test the viability of application in Brazil of the most advanced communication techniques for transmission of educational programs to large masses".

Finally I would like to remark that this paper is practically a resumē of many of our reports, and anyone here interested in more details about the SACI Experiment should contact us for additional publications.