

# Interactive Mathematics for Basic Education: The Venezuelan Experience with IRI

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*Over a million first, second and third grade students in 23 out of the Venezuelan 24 states increase their math skills by participating in this low-cost, radio interactive program. Class sessions are transmitted by radio and the program includes pre-transmission, during transmission and post-transmission activities for the students as well as the use of complementary instructional materials, training for the teachers and internal as well as external program evaluations at both the state and national level.*

Interactive Mathematics for Basic Education is a program designed to raise the quality of Mathematics teaching in the first phase of basic education in Venezuela, which corresponds to the first, second and third grades. In this method, active listening to radio programs is combined with classroom activities, in order to develop the subject's content areas during this phase. The program was developed by a Foundation, the National Center for the Improvement of Science Education (CENAMEC) under the auspices of the Ministry of Education. At first, it was financed by the Venezuelan private sector, then by the World Bank during the period of its greatest expansion.

The program was created in order to help resolve the problem of low levels of quality learning in this subject. Additionally, given that this problem is greatly tied to deficiencies in the training and updating of math teachers, the program was devised as a system of permanent training for teachers through the use of their own resources. In order to accomplish these objectives, the program offers the following support to participating classrooms: a radio, a teacher's guide, a package of complementary materials, the daily transmission of a radio program "Matemática Divertida" [Entertaining Mathematics], teacher training and follow up.

The typical Interactive Mathematics lesson or "encounter" contains three important aspects: preparation, listening to the radio program and carrying out activities suggested in the guide. During preparation, the teacher organizes the students and ensures they have the necessary materials ready for the transmission. During the radio program, varied and intensive activities are carried out, monitored by the teacher. To wrap up the "encounter," the teacher carries out activities of evaluation and reinforcement, going more in depth as suggested in the guide, in some cases supported by the complementary materials the teacher receives.

Since its beginnings in 1991, program activities have centered on two fundamental aspects: the production of instructional materials, and the formation of a national administrative structure to manage its implementation.

Program accomplishments can be summarized in three areas: production, implementation and evaluation.

## **Production**

### *Radio Programs*

Production initiated with the series for second grade, which was an adaptation of Radio Mathematics of Nicaragua, the first series produced in the world utilizing the Interactive Radio technique. The third grade and first grade series were completely designed and executed by staff of the Interactive Mathematics team.

Interactive Mathematics produced three series of the radio program Entertaining Mathematics: 125 programs for first grade, 140 for second and 135 for third. The series follow the customary format of Interactive Radio, in the sense that they are programs lasting approximately 30 minutes that combine instructional segments with recreational segments, aside from others in which the two functions are combined. They also implement distributive practice in that at the beginning of the year topics are addressed which continue to be deepened in complexity and difficulty throughout the rest of the year.

The radio program, Entertaining Mathematics, is dramatized and each series develops in a particular context. The characters become familiar to the students, who carry out different kinds of activities with them. Music is used through songs that are especially composed for the series. The programs also use stories and adventures with situations in which mathematics procedures have to be applied, as well as riddles, math games and physical exercises.

### *Teacher's Guide*

A Teacher's Guide, divided into the following sections accompanies each series: Introduction, Instructions, Planning, Evaluation, Encounters, Songs and Special Activities.

- ? *Introduction.* Presents the program objectives, the principles of the technique of Interactive Radio, the general structure of classes or encounters, a description of the teacher's role, the principles that guide the formulation of the program, didactic considerations with regards to the content to be covered during the year, and a description of the resources necessary to carry out the classroom encounters, including a description of the materials contained in the packet of Complementary Materials.
- ? *Instructions.* Guidelines for carrying out an encounter in the classroom.
- ? *Planning.* Contains a detailed description of the topics covered throughout the year and the encounters within which they are dealt. In addition, this section contains a table in which the context of each encounter is summarily described and is tied to other areas such as language and the natural sciences, with the goal of helping the teacher relate math concepts to other areas of application. Finally, there are some suggestions for evaluating the students.
- ? *Encounters.* Contains information about the materials required for the activities of each of the encounters, the exercises that are going to be carried out during the transmission, the materials necessary to follow along, as well as a brief description of the activities to be carried out during the transmission. Also, two activities are suggested that the teacher can conduct with the students in the classroom after the transmission is over.
- ? *Songs.* Contains the words to the songs in the program.
- ? *Special Activities.* Contains the development of some activities that are considered special because they require more advanced work in order to be carried out, and they cover the development of a concept from its first approximations through some of its applications. Thus, they generally require various sections in order to be completed.

### *Complementary Materials*

For each grade a packet of Complementary Materials was designed to carry out some of the activities during and after the transmission. This contains:

- ? Materials to create an atmosphere in the classroom, such as posters and illustrations.

- ? Concrete materials: logic blocks, metric tape, bills and coins, mosaics, molds to construct geometric shapes, cards.
- ? Worksheets.
- ? Work notebooks.

### *Development Process of the Series*

The series that correspond to 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> grades have followed a process that consists of the following phases:

- ? A pilot phase in a small sample of the Federal District. This phase consisted of a limited production of programs that included strategies to be utilized in the complete series, in order to carry out an initial formative evaluation before proceeding to write the entire series.
- ? A trial phase in a larger sample, also in the Federal District. During the year in which this series was produced, the programs were transmitted as they were produced. This allowed for a more in-depth evaluation of the aired material. In this way, mistakes could be detected and corrected early, thus saving time and effort down the road.
- ? An extension phase to various states away from the capital. Each state started with 2<sup>nd</sup> grade, and in the following years they incorporated 3<sup>rd</sup> and 1<sup>st</sup> grades. Once the first grade was established, new states started with that grade, following the normal sequence.

## **Implementation**

### *Organizational Structure in the States*

In each state there are two teams in charge of managing the program; the coordinating team, headed by a regional program coordinator, and a team of facilitators.

The coordinating team carries out planning, designs a statewide program budget, negotiates and signs agreements and contracts with the governments and the radio stations that transmit the program, distributes and controls program materials, plans the workshops for directors and teachers, communicates with the central team, and in general, deals with any issue having to do with the program in the state. Usually, this team is made up of a coordinator and two or three people assigned by the government, although in some cases there can be up to ten people in a state coordination team.

Another important function of the coordinating team is to carry out follow-up with classroom participants to verify the correct application of the program, as well as to offer support when necessary.

The team of facilitators is selected by the coordinating team to train the teachers who enter the program. This team is made up of a combination of integral education teachers and mathematics teachers who receive special education and remuneration for the workshops they offer. The next section briefly describes what this training consists of.

### *Training*

Several kinds of workshops are offered to inform and train the different participants in the program. These are:

- ? *Workshops for the regional coordination teams.* The central advisors lead these workshops. The team is taught the processes to follow in order to start up the program in their state: agreements with the

government, contracts with the schools, the gathering of directors and teachers and the organization of teacher workshops, among others.

- ? *Training workshops for state facilitators.* The central team leads these workshops. The participants in these workshops are evaluated and only those who achieve an approved level are certified to do training.
- ? *Workshops for supervisors and directors.* The state facilitators themselves lead these workshops. The directors then select the teachers from their respective schools who are going to attend the training workshops as a prerequisite to registering their sections.
- ? *Teacher training.* Local facilitators who pass the previous workshop train the teachers from each grade. This training consists of a ten-hour workshop, specific for each grade, in which the teacher is instructed in the technique of Interactive Radio and in the most important teaching strategies that are going to be developed throughout the year. The sections are registered once their teachers receive this training.

### *Follow-up*

The follow-up is performed at regional and central levels. What follows is a description of both processes.

- ? **Regional Follow-up:**
  - ? Visits to a sampling of participating schools. These visits can be of two types:
    - ? Supervision of a complete encounter of Interactive Mathematics, including the pre-transmission activity, the transmission and the post-transmission activities.
    - ? A technical visit, which consists of going to a school and visiting all the participating classrooms. Through the inspection of the classroom environment and a review of student workbooks, it can be determined if the program is being followed in that class and if it is being carried out adequately. These visits also involve oversight of the school personnel.
  - ? Meetings with supervisors, directors and teachers.
  - ? Teacher support circles. These are being put into practice in some states, consisting of meetings of teachers from different participating schools who share ideas about the program, with the goal of reaching a larger number of teachers than would be possible if the follow-up were only done through visits.
- ? **Central Follow-up:**
  - ? Periodic visits to the states. These visits address issues of common interest to both teams, and issues are resolved in meetings with regional teams.
  - ? Visits to a sampling of schools during the state visits.
  - ? Oversight of the allocation of equipment and materials to the coordinating teams.
  - ? Oversight of the management of state coordination teams—agreements with governments, contracts with radio stations, inventory control and a plan for recruitment and follow-up with sections.

### *Population Served*

To this date, approximately three million students have been served. By December 2000, we hope to have the capacity to serve 1,200,000 students a year, distributed in 40,000 classrooms in 11,000 schools. The program is extended to 23 of the 24 Venezuelan federal entities.

## The Media

- ? 29 radio stations transmit the “Entertaining Mathematics” programs throughout the country.
- ? Local newspapers publish the notices with slates of the printed materials necessary to follow the radio transmission.

## Costs

<b>Series Production</b> (125 programs):	
Total	\$375,000
Per program	\$ 3,000
<b>Materials and Equipment</b>	
Radio	\$ 40 (Duration: 5 years)
Radio batteries	\$ 2
Teacher’s Guide	\$ 8 (Duration: 5 years)
Complementary materials	\$ 7 (Duration: 1 school year)
<b>1997 Calculations</b>	
Series transmitted:	2 <sup>nd</sup> and 3 <sup>rd</sup> grades
Number of students:	336,000
Average number of students per class:	30
Number of participating sections	11,200
Number of radio stations	23
<b>Costs of transmission</b>	
Total per school year	\$105,000
Average per radio station	\$ 4,565
<b>Follow-up and training</b>	
Total per school year	\$ 274,166
Cost per classroom	\$ 25
<b>Recurring cost per school year per classroom or Section</b>	
Follow-up and training	\$ 25
Radio Transmissions	\$ 9.37
Radios and teachers guides	\$ 9.6
Complementary materials and batteries	\$ 9
Total cost per class or section	\$ 53
<b>Total cost per student</b>	\$ 1.76

## Evaluation

Various evaluation processes have been carried out, both formative and summative. Summative evaluations have been carried out internally by the Interactive Mathematics team, as well as externally by outside companies contracted specifically for that purpose. Both processes are briefly described below, along with a general commentary about the results of these evaluations.

### Internal Evaluation

- ? *Formative evaluation of the programs during the production process.* As the radio programs were produced, they were transmitted in the participating classrooms and observations were made about each one of the encounters to make the necessary adjustments. In this way, a product could be created

from the beginning that would not need extensive corrections later on, because improvements were made as problems were being detected.

? *Comparative studies of the children's learning between an experimental group and a control group.* These evaluations generally consisted of comparative studies between an experimental group and a control group. Some of the studies carried out were the following:

? First trial of first grade. Initially, the students in the experimental group were below the level of the control group students. By the end of the year, the experimental group reached the control group, achieving learning gains that were significantly greater than those of the control group.

? Measurement of knowledge of children entering fourth grade. A comparative study was carried out between fourth grade students who had studied under the Interactive Mathematics system and others who had followed traditional methods in the Federal District and the states of Lara and Mérida. The experimental group had significantly higher results than the control group.

#### *External Evaluation*

? *Comparative studies of children's learning between an experimental group and a control group.* Four studies were carried out: the second grade trial in Caracas; a national evaluation of second grades the year that it extended to other states; an evaluation of the third grade trial; and, finally, a national study that included second and third grade. In all except one, the study of second grade at the point it was extended, the results were significantly higher for the experimental group than the control group.

? *Evaluation of program implementation.* The aspects studied with respect to program implementation were the following:

? Use of the materials provided by the program. These studies consistently revealed that 90 percent of the registered teachers follow the radio program, and 60 percent carry out all of the programmed activities before, during and after the transmission.

? Teacher's attitude towards Mathematics and the program itself. In the evaluations as well as in the follow-up process, a change in the teachers' attitudes towards the subject could be observed, in the sense that they feel more comfortable teaching math as a result of the availability of a well planned and accessible resource. In an evaluation carried out by National Supervisors of the Ministry of Education in the 1998-99 school year, the program turned out to be the one most well known and accepted by teachers at the national level.

? Student change of attitude. Students like the program and changes are reported that affect not only the Mathematics class, but all their other classes as well. For example, students pay better attention, as a result of having to listen attentively to a daily radio program.