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Quarterly Report

July - September 1990

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RADIO LEARNING PROJECT QUARTERLY REPORT
JULY - SEPTEMBER 1990

The Radio Learning Project Quarterly Report includes a summary of major activities over the past several months and copies of significant project documents that represent the project's major activities. Typical documents include evaluations, conference reports, and papers. For further information on any of the activities or for a complete catalog of RLP publications and other materials, please contact the Radio Learning Project.

This final issue of the Quarterly Report includes three cost studies on interactive radio projects--Bolivia, Honduras and Lesotho. In addition there is summary report on the Radio Science Project in Papua New Guinea. The preparation of these four reports was financed, in part, by the World Bank and will be included in a modified form in an up-coming World Bank book, Technology and Teaching: Elements of Sustainability in Developing Countries, ed. Marlaine E. Lockheed, John Middleton and Greta S. Nettleton. All of these reports examine key issues of sustainability.

This Quarterly Report also includes the Radio Learning Project final report on interactive radio activities in Honduras. RLP has been assisting AVANCE, a private, non-profit organization, to develop a radio-based mental arithmetic series for children in grades 1-3. AVANCE has also adapted the first-grade English as a second language program, originally developed in Africa, for use in Latin America. The series is presently being used in Belize.

Finally, we include an update on an important program in the Dominican Republic where interactive radio is helping to meet the needs of children who do not have access to traditional primary schools. The IRI lessons of RADECO (Radio-Based Community Education Program) will move from the remote rural areas of the country to the urban slums of Santo Domingo where there are an insufficient number of primary schools.

The Bolivia cost study concludes that the cost-effectiveness of mathematics instruction in Bolivia using the Radio Education Project (REP) is about 70% higher than the cost-effectiveness of traditional instruction. The study measured the effect size association with a year of traditional instruction.

The Honduras study found evidence that introduction of new textbooks and radio lessons was effective, and that a combination of the two yields significantly high learning gains. In this study efficiency was measured by the ratio of the incremental benefits (in terms of effect size) to the incremental costs.

The Lesotho study summarizes the status of English in Action series, which is being used in over 90% of the primary schools in the country. This paper also includes a study of the costs - both development and recurrent costs.

The report from Papua New Guinea sums up the experience of the Radio Science Project as it progressed from the development stage to full national implementation. The Radio Science Project utilized the IRI methodology to teach and develop a science curriculum for grades four, five and six in Papua New Guinea, becoming the first tested model of IRI's ability to teach science in a developing country. The radio science programs will become institutionalized in Papua New Guinea in 1991, and plans are underway to make IRI a basic component of instruction for a new science curriculum currently being developed by the National Department of Education.

The RLP continued to disseminate information about IRI to ministries of education in developing nations, particularly in Africa. In September, RLP collaborated with Zimbabwe's Ministry of Education and Culture to conduct a workshop on Radio for Effective Teaching for 35 educators from various departments of the Ministry. In early September Tom Tilson made a presentation on IRI at the A.I.D.-sponsored Workshop on Basic Education Development in Africa: Lessons Learned, held in Lome, Togo. Interest in IRI remains high for African educators and MOE officials from Cameroon, Ghana, Guinea, Mali, Nigeria, Uganda and Zimbabwe have requested information and support for possible IRI activity in their countries.

The Radio Learning Project ended on September 30, 1990. However, the new Learning Technologies for Basic Education Project (LearnTech Project) will carry on the work of the Radio Learning Project, and then some. The LearnTech Project picks up where the Radio Learning Project left off -- some 600,000 children in Africa, Latin America and Asia learning by interactive radio in mathematics, English as a second language, reading and writing, science and health.

The LearnTech Project also follows on another A.I.D. project, the Educational Technologies Studies and Applications Project which focuses on the development of other technologies for improving basic education.

Thus, the new **LearnTech Project** will provide information, materials and technical assistance to ministries of education, USAID missions and other donors *on how technologies can help improve basic education in developing countries*. As with the Radio Learning Project, Education Development Center (EDC) will again be the prime contractor. But the new consortium is much larger with a broader range of expertise from institutions in six nations. We are committed to helping educators find the best solutions to improving the curriculum, to training teachers, and

to providing educational opportunities for individuals presently denied access.

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This Quarterly Report includes the following documents:

The Radio Mathematics Project in Bolivia: A Cost-Effectiveness Evaluation. Dean T. Jamison, UCLA.

Evaluation of Development and Recurrent Costs for "La Familia de los Numeros". Patricia Godoy-Kain, Development Technologies, Inc.

Radio Learning Project/Honduras: Final Report. David C. Edgerton, Radio Learning Project.

Lesotho Radio Language Arts Program. Maurice Imhoof, BANFES Project and Thomas D. Tilson, Radio Learning Project.

The Radio Science Project in Papua New Guinea. Tom Roy, Radio Science Project.

The RADECO Project. John Helwig, Radio Learning Project.

THE RADIO MATHEMATICS PROJECT IN BOLIVIA: A COST-EFFECTIVENESS EVALUATION

September 28, 1990

This document comprises the final report under EDC Radio Learning Project Purchase Order of July 22, 1990, with Dr. Dean T. Jamison of the University of California, Los Angeles.

THE RADIO MATHEMATICS PROJECT IN BOLIVIA: A COST-EFFECTIVENESS EVALUATION

THE RADIO EDUCATION PROJECT IN BOLIVIA: A COST-EFFECTIVENESS EVALUATION

Beginning in 1987, the education authorities in Bolivia, with financial support from the U.S. Agency for International Development, began a process of developing, testing and implementing a program of "interactive" radio to carry the main burden of instruction in mathematics in grades 2 through 5 of elementary school. Lessons for grades 2 through 4 are now available , and in 1991 18 transmitters will broadcast lessons in grades 2 through 5 to 70,000 students spread throughout 5 of Bolivia's 9 Departments. By that time, the development phase of the project will have been completed and implementation will be well under way.

The Bolivian Ministry of Education and Culture is now actively considering expansion of coverage of the project to all 600,000 children in grades 2 through 5 of Bolivia's schools. The purpose of this review is to help inform that decision by assessing the cost and cost-effectiveness of radio mathematics in Bolivia; the project has now been underway sufficiently long that this assessment can be undertaken with some confidence. While primarily oriented toward decision-makers in Bolivia, this evaluation also seeks to serve a broader audience by explicit consideration of the development costs that, from the perspective of Bolivian decision-makers, are now "sunk" and can, therefore, be disregarded. This evaluation begins, in Section 1, with background on the experience with interactive radio elsewhere and its development in Bolivia; Sections 2 and 3 discuss effectiveness and its measurement; Section 4 assembles available evidence on costs - both of interactive radio and of regular classroom instruction in Bolivia; and Section 5 concludes by drawing together the evidence on effectiveness and on cost into a cost-effectiveness assessment.

1. BACKGROUND

1.1 History and Description of Radio Mathematics Instruction

Since 1974, experience in 12 countries in Latin America, Africa, and Asia has demonstrated the power of an alternative instructional model called interactive radio to teach, motivate, and enrich the classroom environment at low-cost. Rigorous field evaluations of pilot-radio activities have proven the interactive-radio methodology to be a cost-effective mechanism for improving the efficiency, accessibility, and quality of education systems in developing countries. Previous projects have also demonstrated that instructional radio can effectively teach mathematics, science, and language both to children in the formal and nonformal environment. At the same time, teachers' own knowledge of basic subject matter is reinforced.

Interactive radio is different from other educational-technology alternatives because it is a breakthrough in instructional design combining the basic principles of educational psychology with the particular characteristics of radio. In contrast to most previous applications of radio in the classroom, which were typically for "enrichment" of ongoing classrooms instruction, interactive radio carries the main burden of instruction in the subject matter being taught. The extent to which these programs are able to actively engage children in learning activities has been a critical factor in the success of the model. Interactive radio initially received its name from the creative approach of its lively broadcast style which gives the impression of a rapid-fire dialogue between "radio teacher" and student. Interactive-radio lessons call upon children to respond orally to questions, sing learning songs, write on worksheets, do mental exercises, or join in physical activities every 20 or 30 seconds. Each program also includes intensive drill and practice, both oral and written, where students' responses are immediately reinforced by the correct answer. This frequent student response applies an important pedagogical principal--that learning is most effective when students are actively involved in the learning process.

Interactive-radio programs are designed to provide direct instruction to students. Each curriculum generally consists of approximately 150 half-hour lessons which are broadcast every day of the school year and followed by a 15 minute teacher-led postbroadcast period. During the radio lesson, radio teachers (actors in the radio programs) systematically present and explain new material and review basic subject matter in an understandable, interesting, and pedagogically effective way. The lessons also introduce new learning concepts, engage students in problem-solving activities, and lead students to subject mastery through inductive and participatory activities. By carrying the burden of instruction directly into the classroom, interactive radio enables the teacher to monitor the progress of individual students during the broadcast, without interrupting the pace of the class. Multigrade teachers may work with a different group of students altogether. Once the radio lesson is over, teachers' continue to intensify specific themes using a complementary teachers' guide.

Robust formative evaluation serves to reinforce the efficacy of the interactive methodology through its research-driven design. The feedback-feedforward formative evaluation loop, unique to the interactive model, is used to fine-tune the curriculum as it is being developed. Daily observations of student interaction with the radio broadcasts are recorded and weekly tests of student achievement are administered. This feedback is then used to form future lessons and also to revise old lessons. For example, if a large percentage of students fail to master a certain set of instructional objectives, formative feedback is used to decide whether to introduce new concepts, to review old materials, or to

modify lesson format and methodology. Once a segment is "reformed", it is broadcast in its new format at a later date. In other words, formative research provides critical input to the on-going process of developing an effective interactive curriculum.

1.2 Prior Evidence on Effectiveness and Costs

The Radio Mathematics Project, carried out in Nicaragua from 1974 to 1979, developed and field-tested the first, interactive-radio curriculum in mathematics. Using the official Nicaraguan curriculum as a base, this model project produced major improvements in student learning of math in grades one through four. Comparisons of posttest scores for experimental and control classes demonstrate that students in the radio classes consistently outscored students in conventional classes on tests of mathematics achievement, Table 1.1, from Friend et al (1980, p. 123).

A separate, carefully controlled study compared first grade achievement gains in Nicaraguan radio classrooms and in textbook classrooms with those in control classrooms (having relatively limited access to textbooks and no access to the radio programs). The results indicated that both radio classes and textbook classes scored significantly higher than the control group on mathematics achievement tests. In fact, students in the radio group outperformed students in the textbook group. The results showed control classes with 44.3% correct; textbook classes with 48.7% correct; and radio classes with 62.1% correct. (Jamison, et al, 1981).

In 1980, Thailand began adaptation of the Radio Mathematics curriculum originally developed in Nicaragua. Despite the cultural and language difference between the two countries, the Thai adaptation produced significant results in student performance. By 1983, the project was broadcasting first, second, and third grade lessons to 50 experimental schools in five provinces, as well as first and second grade lessons to an additional 500 non-experimental schools. In 1984, grades 1-3 were broadcast nationally. Radio classes did better than control classes in every region in all three years. In addition, the test results indicate that the radio programs are contributing to regional equity by narrowing the urban/rural learning gap.

Lockheed and Hanushek (1988) have provided a valuable summary of the results of evaluations of the Nicaraguan, Thai and other interactive radio project as one element of a wide-ranging review of available evidence on the effectiveness and cost-effectiveness of educational Investments in developing countries. Rather than further describe specific results here, we simply note that interactive radio projects consistently had the highest effectiveness and among the highest cost-effectiveness of the projects studied.

TABLE 1.1
Comparison of Posttest Scores for Experimental and Control Classrooms, Nicaragua

Grade	Year	Experimental			Control			
		N Classes	Mean % Correct	*SD*	*N* Classes	Mean % Correct	*SD*	*t*
1	1976	30	65.4	3.9	23	38.8	5.4	20.83*
2	1977	40	66.1	5.5	24	58.4	6.3	5.13*
3	1978	24	51.7	8.9	24	43.2	6.6	3.76*
4	1978	29	34.7	8.6	19	33.8	8.7	.35

* $p < .01$

1.3 Radio Mathematics in Bolivia: Program Evolution and Prospects

The Bolivian Radio Education Project (REP) was initially designed to provide high-quality instruction at the primary-school level through national dissemination of locally-adapted interactive-radio curricula. Prior to the initiation of any large-scale activities, the staff of Fe y Alegria (a Bolivian organization) and Education Development Center (from the U.S.) conducted a small pilot study to assess the feasibility of adapting the Nicaraguan radio math curricula to Bolivia. From April to July, 1987, the REP staff adapted, produced, and broadcast the first 20 lessons of the second-grade radio-math curriculum. A total of 450 students in 11 second-grade classrooms in two regions of Bolivia participated in the pilot study. Based upon the strong learning gains experienced by the radio cohort, it was concluded that: (1) the radio math curriculum developed in Central America and adapted in the pilot not only meets but expands upon the official Bolivian curriculum; (2) Bolivian school children entering second grade have the necessary prerequisite skills in numeration, basic addition, and simple subtraction to "take-off" with the radio lessons; and (3) Bolivian teachers can effectively use the interactive-radio programs in their classrooms with a minimum of training.

Encouraged by these positive findings, EDC began collaborating with Fe y Alegria to produce and disseminate the entire interactive-radio curricula for primary-school mathematics, grades two through five. Because of the high degree of similarity found between the Nicaraguan and Bolivian second-grade curricula during the pilot test, the project was designed with adaptation in mind. Prior to starting developmental activities, the Nicaraguan radio mathematics curriculum and the official Bolivian curriculum were compared to assess the degree to which the content of the programs originally developed and validated in Central America would need to be modified in order to integrate them with the Bolivian curriculum. In general, REP was able to match the two curricula at the second-grade level with straightforward modifications to the context of the lessons including music, language, cultural and geographical relevance; changes in specific learning and entertainment segments such as word problems, songs, and games; and minor alterations in the way that two algorithms, subtraction and multiplication, were taught. The overall structure of the mathematical content of the original programs remained largely untouched. Review of the third and fourth grade curricula indicated, however, that a more extensive revision of the instructional package, equivalent to about 20% for third grade and 60% for fourth grade, would need to be undertaken at each level. Given the various grades of difficulty involved in the adaptation, REP began with the second grade programs. In this way, the curriculum team was able to develop a solid understanding of the interactive-radio methodology prior to undertaking the more complex work associated with adaptation of the third and fourth grade

curricula. Development of a fifth-grade radio-math curriculum was not originally planned; however, participating teachers soon began to request that REP maximize the longitudinal impact of its programs by continuing interactive-radio math instruction through all five years of primary school. Thus, in 1990, Bolivia began development of the first interactive-radio mathematics curriculum for fifth grade.

The Bolivian interactive-radio lessons are broadcast for 25 minutes every day of the school year. In addition, teachers are provided with a guide, developed by the project, to intensify the mathematical concepts delivered by the radio during a complementary 15 minute post-broadcast session. Since its inception, REP has developed and broadcast 405 half-hour radio-mathematics lessons for approximately 50,000 second, third, and fourth-grade students in Bolivia. Five of the country's nine departments have participated in this program to date; and in 1991, more than 70,000 students are expected to participate in the project. Table 1.2 summarizes the growth in geographical, curriculum, and student coverage of REP.

TABLE 1.2
Growth of Radio Mathematics Coverage and Enrollment.

Year	No. of Departments[a]	No. of Transmitters	No. of Schools	No. of Students[b]	Grades Covered
1988	3	8	145	10,284	2
1989	5	10	182	12,600	2,3
1990	5	18	367	25,000	2,3,4
1991	5	18	900	70,000	2,3,4,5

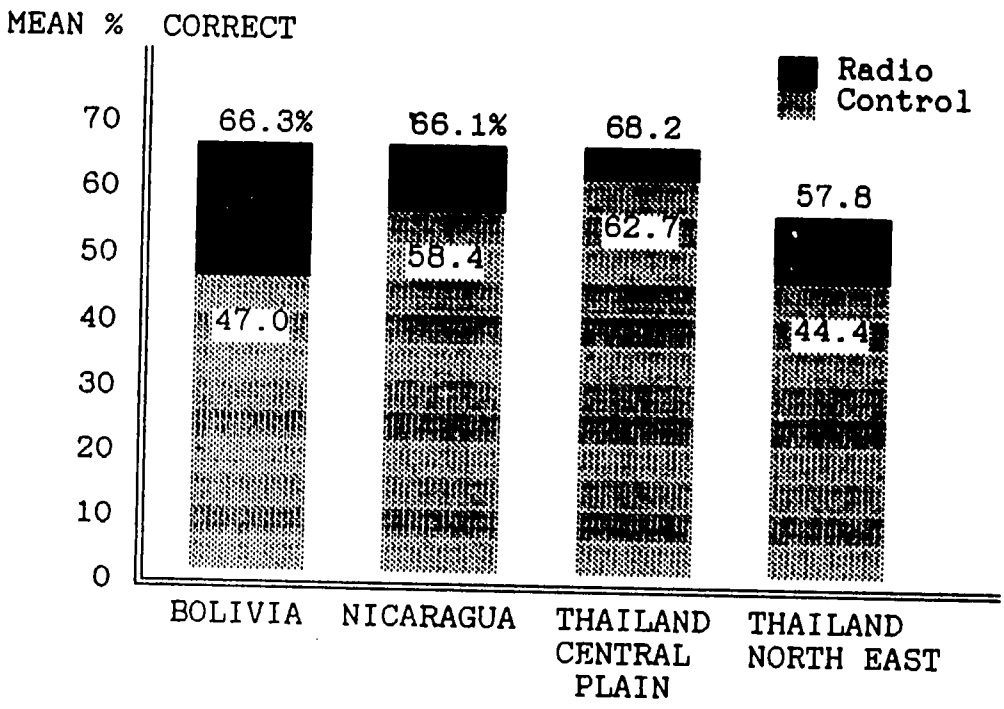
a) This is out of 9 Departments nationwide.
b) This is out of approximately 600,000 primary students in grades 2-5 nationwide.

1.4 Radio Mathematics in Bolivia: Summative Evaluation Results

In order to assess the impact of the instructional-radio programs, the project employed both formative and summative evaluation strategies. Daily classroom observations and interviews with teachers were used to provide qualitative data--to investigate whether the children enjoyed the lessons, whether teachers worked well with the radio, and so on. Tests also provided quantitative data on children's achievement. These data were then used to tailor the math programs to the average students' learning abilities. This subsection reviews the results of the second-grade summative evaluation conducted in 1988, and states preliminary results from the third grade longitudinal evaluation conducted in 1989. (Sections 2 and 3 of this paper report results from evaluation of 2nd and 3rd grade effectiveness conducted specifically for this cost-effectiveness evaluation.)

Second Grade Summative Evaluation, Mathematics, 1988. The purpose of the summative evaluation is to measure the effectiveness of the interactive-radio mathematics curriculum in terms of learning outcomes. The 1988 evaluation used the same classrooms in two different years--the first year for the control group and the second for the experimental group. In the final two weeks of the 1987 school year, a mathematics achievement test was administered to children who were completing second-grade mathematics using conventional (teacher-led) instruction and who had not been exposed to the radio treatment. The following year, the same classrooms became part of the experimental group and a new cohort of second-grade students was given the radio mathematics lessons in place of their regular math program. All other subjects were taught in the conventional manner. At the end of the 1988 school year, the same posttest was administered to the students who used the radio lessons. Although the children in the experimental group are not the same as those who were tested earlier, they nevertheless come from the same neighborhoods and sometimes from the same family; they had shared the same classrooms and occasionally the same teachers; and they generally tend to be from a similar socio-economic class. A total of 1554 students in 50 randomly selected urban, periurban, and rural classrooms in three Departments were included in the sample.

The results indicate that the Bolivian Radio Education Project has yielded the highest gains of any second-grade interactive-radio curriculum to date, Figure 1.1. It therefore seems that the REP's adaptation of the second-grade Nicaraguan radio math curriculum has maintained the level of excellence established in the earlier project, even though the total number of lessons was reduced from 175 to 130.



EFFECT SIZE: .91 .58 .24 .58

Figure 1.1 Comparison of Posttest Means for Experimental and Control Classrooms, Grade 2 Mathematics, Bolivia, Nicaragua, Thailand.

The control and experimental cohorts were next analyzed by location (urban, suburban, rural) to see what effect urbanization might have on student learning, and then to test the hypothesis that interactive-radio instruction has a positive impact on narrowing the urban-rural learning gap.

The distribution of learning gains in Bolivia follows the same pattern that has been established in other countries using interactive-radio. The highest learning gains are in the suburban and rural areas where traditional teacher-led instruction is the weakest. The lowest mean gains are in the urban areas where you generally find better students, better teachers, and better schools. In Bolivia, the experimental groups in rural schools not only demonstrated strong learning gains, but their posttest score (57.3%) exceeded the average score for urban students in the control group (55.1%).

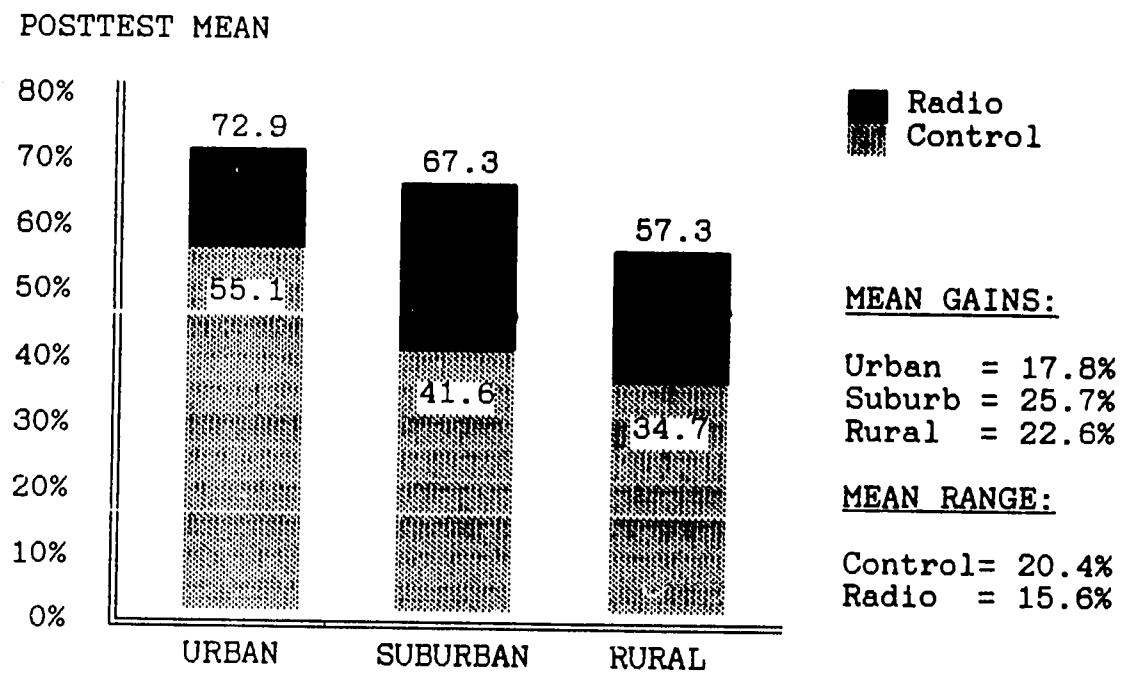


FIGURE 1.2 Comparison of Posttest Scores for Urban, Suburban, and Rural Students.

Third Grade Longitudinal Evaluation, Mathematics, 1989. In an attempt to measure the cumulative effect of the treatment over time, REP modified the third-grade summative evaluation design to include a tracer study of those children who were originally tested as part of the Grade Two experimental cohort, and had gone on to complete the third grade radio curriculum. Figure 1.3 shows that after one year of radio mathematics instruction (third grade only), the experimental cohort's mastery of basic mathematics was clearly superior to the control group's. Even more impressive, however, is the gain of the longitudinal group who had taken radio math in both second and third grades, strongly suggesting a cumulative impact of the instructional radio curriculum over time.

The most effective way of measuring the efficiency of interactive radio as an instructional intervention is through its effect size. Effect size is a powerful educational statistic because it can measure the impact of an intervention using criterion independent of the specific test used. To measure how great the effect of the interactive-radio math program is in comparison with traditional instruction, we used the effect size statistic to calculate the mean difference between the control, experimental, and longitudinal groups in terms of the standard of deviation of the control group; the results indicated in Figure 1.3 are dramatically high effect size measures inn the extent of the education literature.

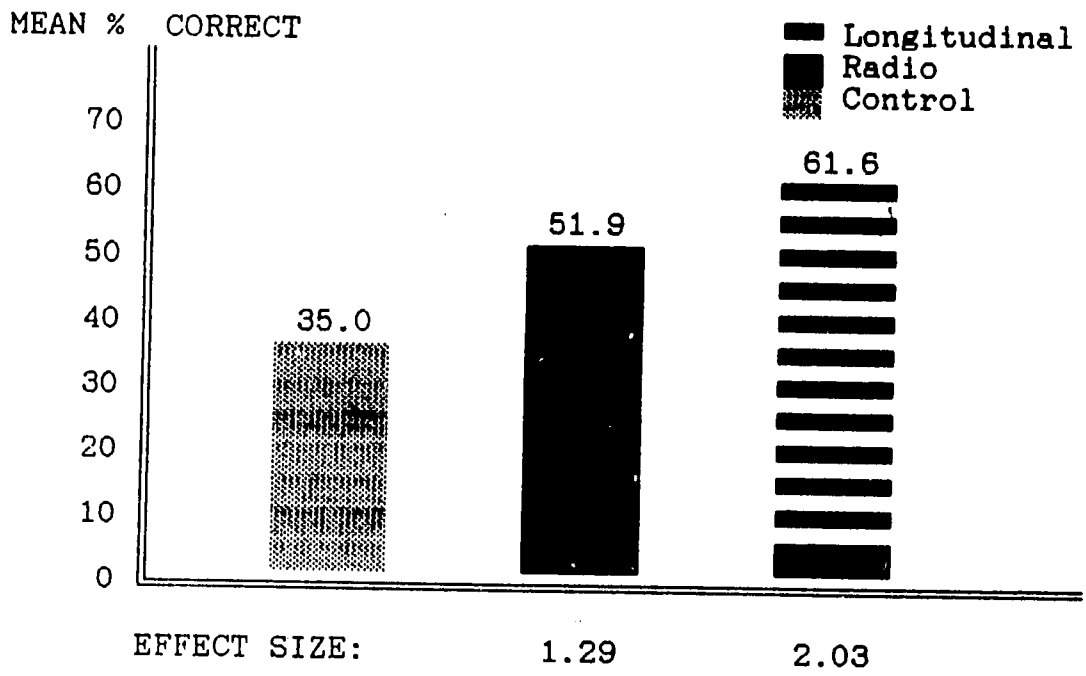


Figure 1.3 Comparison of Posttest Means for Control, Experimental, and Longitudinal Classrooms, Third Grade Mathematics, Bolivia

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2. ASSESSING EFFECTIVENESS: INSTRUMENTS, SAMPLE, AND DATA COLLECTION

One important facet of this cost effectiveness evaluation was the collection of a new set of achievement data that would allow explicit comparison of the impact of the REP relative to the impact of a year of traditional mathematics instruction. To undertake this assessment, the same test was given to second and to third grade students in 12 schools in and near the city of Cochabamba. Students from both radio and control groups at both grade levels were tested, and the selected schools included rural, suburban, and urban.

The result of this pattern of testing is to allow comparisons like those illustrated in Figure 2.1. The objective is to be able to measure the achievement gains induced by the REP in terms of how much a student gains in one year of traditional instruction; Section 3 reports the results.

What follows in Section 2, consists of brief descriptions of the study area, instruments, and data collection procedures.

2.1 Study Population and Schools

In Bolivia, the Quechua Culture expands over more territory than the Aymaras and other ethnic groups; its principal settlements are in high mountain valleys, specially Cochabamba, the site of this evaluation effort. The temperatures range from sixty to seventy degrees Fahrenheit (20-25°C). The altitude above the sea level is an average of 6500 feet (2,000 meters). For this reason, the vegetation is exuberant, the agricultural production consists of diverse varieties of corn, wheat, vegetables and fruit, such a grapes, pear, apple. In addition to all this, the Quechua breed cattle, sheep, and domestic birds.

Some rules of community organizations are still kept such as the AYLLU which is a basic unit of social organization in the Andes. It is ruled by an elder under and moral and ethic principles, as shown by the code: AMA KELLA, AMA SUA, AND AMA LLULLA that mean: Don't be lazy, don't steal and don't lie. Furthermore the Ayni is also kept, being the exchange and material help that all members of the community provide to one another.

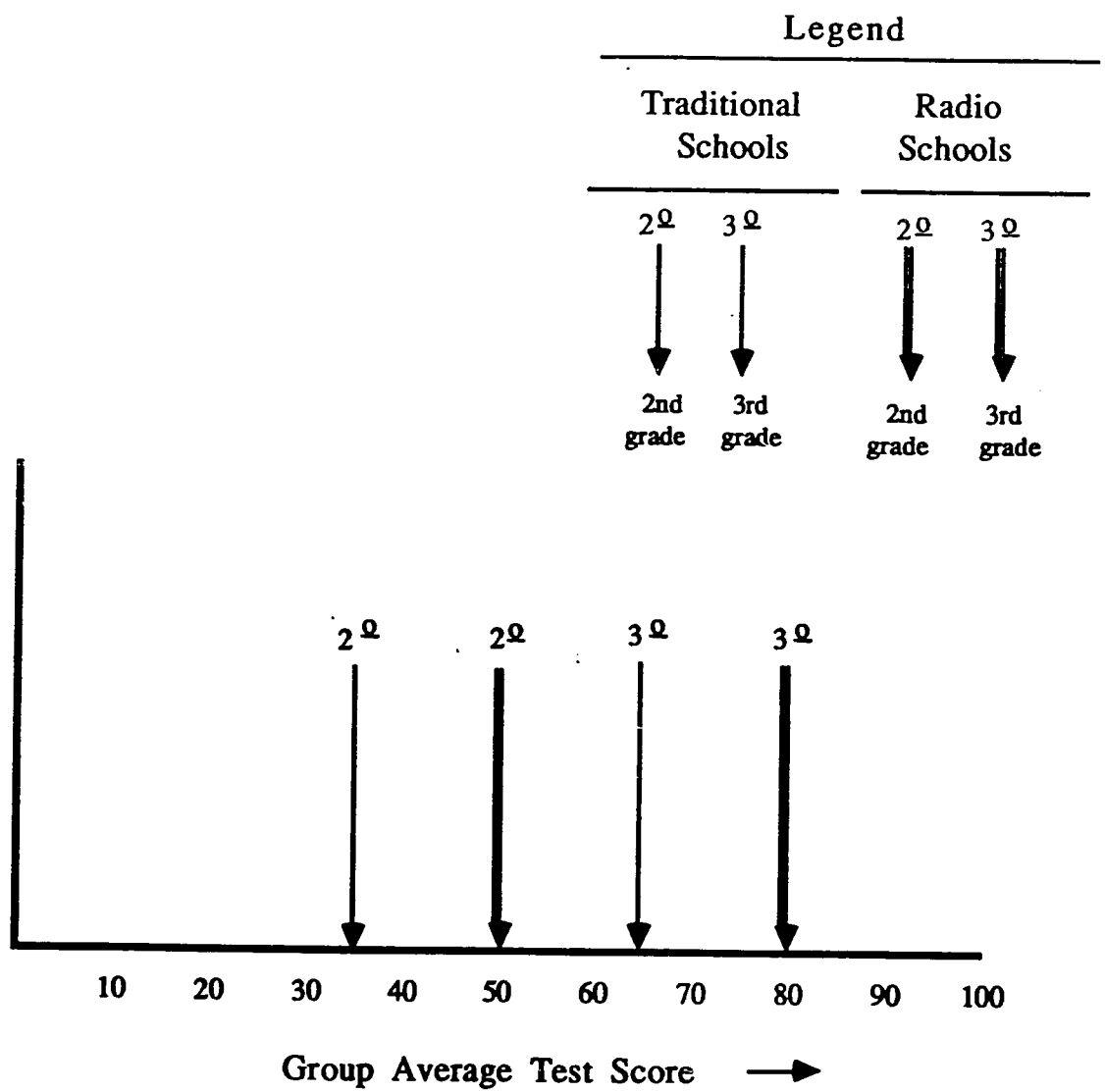

Figure 2.1: Control and Treatment Comparisons (Illustrative)

Xavier Albo, an anthropologist affirms, "...the person from Cochabamba or "ckochala" has certain characteristics that make him different from others (in Bolivia), and those are his ability to do business, his ability to interact and cope with any other group or organization, and his traveling spirit..." It is not surprising to see a "Cochabambino" self-employed in the commercial sector; and at the height of the mining boom, many people from the Cochabamba valley migrated to the Andean highlands of Oruru and Potosi. This is one of the reasons that the language and customs of the Quechua culture are predominant in the Andean zone. More recently, Cochabamba has become a common destination for different migrant groups from other areas of Bolivia, mainly from the tin mines, after their closing during Dr. Paz Estensoro's government.

For the purposes of the present paper, we have classified our sample into: a) urban schools, which are located around the downtown areas of the city; b) suburban schools, which are in the peripheral areas of the city; and c) rural schools, which are located in highly marginal areas, for instance, Obispo Anaya school at Km. 5 on the Cochabamba-Santa Cruz road.

Urban schools are open to all children living in the cities. The parents of these children generally work as professionals or in factory or government jobs (Cochabamba has a shoe industry; concrete, beer, and soft drinks factories; oil refineries; and plastic and tile manufacturers). Although many urban dwellers face major economic problems, they make a major effort to keep their children in school until graduation. In some instances, where the family income cannot support the cost of clothing, equipping (textbooks, notebooks, and pencils), and maintaining children in school, a child of 8 years will be withdrawn and made to work. According to a recent AID-financed study on school desertion, Bolivia's drop out rate is high, particularly among girls. This is because parents traditionally view the education of male children as more important than that of female children. As a result, parents strive to keep their sons in school as long as economically feasible, while they may withdraw their daughters after they learn to read and write.

Teachers that work in Cochabamba's public schools are underpaid and frequently take-on second jobs to make ends meet. The general infrastructure of the urban schools is often characterized by a shortfall of didactic materials, student desks, blackboards, sporting facilities, and other resources that contribute to the students' physical and intellectual development.

Suburban schools have a still more depressing reality since the government has partially abandoned its support of these rapidly expanding schools. Responsibility for the maintenance of suburban schools generally falls on the initiative of parents and teachers who undertake food sales, raffles, and fund raising campaigns to raise the necessary funds. Given the recent growth of Cochabamba,

since the closing of many tin mines, suburban schools can no longer keep up with the public demand for education. It is in the poorer marginal communities of the city that one finds three children sharing a desk made for one student.

Schools located in the rural areas are widely dispersed. Students thus have to walk many kilometers for their education. In addition, the level of teaching in rural schools is low because they are sometimes staffed by non-professional teachers (who did not go to Normal school). Another important factor is the bilingualism, Quechua-Spanish, that students share, and that makes learning difficult. Parents in rural regions are involved in agriculture; the manufacture of chicha, an alcoholic drink; and the sale of domestic birds and other products that they can market in the cities. Unfortunately, prices for such products are low, making it more difficult for the families. Given the subsistence level of income generation in rural areas, high degrees of malnutrition and low levels of learning abound.

The migration problems are at their worse in places like Villa Venezuela and Valle Hermoso where there is no water or access to public health services. Here, households buy their water from private trucks at substantial expense. As a result, children suffer from a range of water-borne diseases. Access to water is a widespread concern in Cochabamba, even in the city, where some neighborhoods only have water from 6 to 8 a.m.

At Pacata Alta, a rural school on the road to Sacaba, the director told REP that the children of the relocated miners in that community, had gone without formal schooling for three years. Instead, they were taught the basics by several university volunteers. Once the school began to function in 1990, under the direction of a religious order, the neighborhood children were placed in second, third, and fourth-grade classrooms so as not to further deter their education. When we visited Pacata Alta to take the test, the school director said "I am afraid that all of my students failed the test. They are not at the same level as other students. Besides, we only just began classes in May."

Some urban teachers commented that parents do not generally support school activities, nor do they participate directly in the education of their children. One teacher in Mayor Ustaris School noted that urban parents rarely review their children's school work, nor do they assist them with their homework. On the other hand, one teacher at Valle Hermoso School mentioned that the parents of children in her school work along with the teachers in school construction and maintenance activities.

There is, therefore, broad variation in the school environments typically facing children in rural, suburban, and urban areas. For this reason, we have stratified our analysis by these three categories.

2.2 Description of Instruments

The objective of the cost-effectiveness study is to provide a better sense of "normal" (non-radio) progress by undertaking testing with the same instrument at two grade levels simultaneously. This assessment of "normal Progress" would both allow for interpretation of the meaningfulness of time of exposure to traditional and radio mathematics instruction, and for an improved cost-effectiveness analyses in terms of cost per unit of learning gain.

The test. In order to measure student achievement at the second and third-grade, a comprehensive test was developed from a pool of more than 60 items previously used in REP's second and third-grade summative evaluations. Although individual questions were selected from the radio mathematics item bank, it should be noted that the evaluation instrument was developed to measure student mastery of those primary learning objectives expressed in the official Bolivian syllabus and not necessarily those emphasized in the radio lessons. Prior to going into the field, both test and the instructions were pretested among 20 second and third-grade students in La Paz. Although La Paz is not representative of a cross-section of the Bolivian population, the short time allowed for this exercise prohibited us from conducting a more extensive pretest in the field. During actual test administration, individual classroom teachers read all relevant instructions while a project representative controlled for timing. The final testing instrument (see Annex 2) takes 45 minutes to administer and consists of four practice questions followed by 40 mathematical items in numeration (5), addition (6), subtraction (5), multiplication (8), division (4), fractions (3), decimals (3), and word problems (6). The practice questions were not included in the final analysis.

Other variables. In addition to the test, a student data sheet (Annex 2) was also developed to collect information on 38 additional variables relating to the socio-economic status of the child, teacher qualifications, and school environment. Unfortunately eight of the 38 questions were not sufficiently explicit in their application and were dropped from the final analysis. Of the 30 remaining variables, 12 provided descriptive data on student age, sex, attendance, repetition, first language, access to textbooks, and home environment; four probed parental literacy and employment; six described the school environment including location, days in session, and previous participation in Radio Mathematics; and eight provided background on teachers age, training, and years of service. These data allow for the possibility of a subsequent, more extensive analysis of the determinants of mathematics achievement than the one reported here.

2.3 Sample Selection

Given the experience to date with effect sizes in radio math evaluations, it was decided that a relatively limited data collection effort would suffice to meet key analysis needs. In conclusion, we decided that two second grade and two third classrooms in each of 12 experimental and control schools would suffice--4 urban, 4 suburban, and 4 rural. Because of the limited amount of time involved in the selection of sample schools, REP decided to conduct the cost-effectiveness study in Cochabamba, site of the project's longitudinal study. This provided the additional benefit of allowing REP to compare the cross-grade test results with those of the 1988 and 1989 summative evaluations conducted in the same experimental schools. Table 2.1 is illustrative of distribution of schools and classrooms participating in the effectiveness assessment.

2.4 Data Collection

The data collection effort consisted of two activities-test administration and student/teacher interviews. Given the number of students to be tested (nearly 1500) and the limited time in which to collect the data (three days), ten members of the REP central staff were transferred to Cochabamba between August 19-22, 1990, and four local interviewers were hired. During the first day, members of the central team were trained in test administration, and data collection techniques including methods for interviewing students and teachers. In addition, the team was also trained in ways that the individual school registers could be used to verify individual interviewee responses. Once trained in their respective jobs, the field staff was divided into four teams consisting of one evaluator and two interviewers each, and provided with a schedule of schools to canvass over the three-day test period. All tests were administered during the morning shift, thus allowing the field teams to meet in the afternoons and review the status of the data collection effort and to correct the tests.

TABLE 2.1
Schools Participating in the Effectiveness Study.

	RADIO SCHOOLS	CONTROL SCHOOLS [1]
Urban	1. Maristas 83 2nd graders tested 84 3rd graders tested	1. Viscarra 69 2nd graders tested 73 3rd graders tested
	2. Jesus Maria 86 2nd graders tested 77 3rd graders tested	2. Mayor Ustares 53 2nd graders tested 33 3rd graders tested
Suburban	1. Santa Luisa de Marillac 82 2nd graders tested 68 3rd graders tested	1. Cuarto Centanario 56 2nd graders tested 68 3rd graders tested
	2. El Salvador 80 2nd graders tested 77 3rd graders tested	2. Guillermo Urquidi 54 2nd graders tested 47 3rd graders tested
Rural	1. Humberto Portocarrero 32 2nd graders tested 40 3rd graders tested	1. Valle Hermoso Central 46 2nd graders tested 44 3rd graders tested
	2. Obispo Anaya 72 2nd graders tested 67 3rd graders tested	2. Pacata Alta 36 2nd graders tested 27 3rd graders tested
Total	435 2nd graders tested 413 3rd graders tested	314 2nd graders tested 292 3rd graders tested

[1] Third grade children who did not take Radio Mathematics in the test year, but who were exposed to Radio Mathematics in second grade, have been dropped from this analysis.

3. ASSESSING EFFECTIVENESS: THE IMPACT OF TIME AND RADIO ON LEARNING

The test score and other results from the data collection effort in Cochabamba were entered into micro-computers at the REP headquarters in La Paz for basic processing. After error checks and clearing, data on students from 48 second and third-grade classrooms in 12 schools were available for analysis. For the cost-effectiveness analysis two basic measures of outcome were sought: the effect of exposure to the REP on test scores and the effect of exposure to one year of traditional schooling on test scores. While many analyses of the impact of educational interventions (such as interactive radio) provide an assessment of impact in terms of increase in % correct on a test or, better, in terms of "effect size" (to be explained below), this assessment remains, inevitably, only partial. The reason is that it lacks a metric by which to judge the educational (as opposed to statistical) significance of whatever effect size is observed. Hence the importance of providing a measure of the effect size associated with a year of schooling; this provides a natural metric for judging the educational significance of alternative interventions, such as REP.

The two brief subsections that follow report, first, on the measured effect of a year of schooling and, second, on the effect of exposure to REP.

3.1 The Effect of a Year of Schooling

Table 3.1 summarizes our analyses of the effect of one year of schooling (from mid-second to mid-third grade) on student performance in mathematics in Bolivia. The results are reported in the aggregate as well as separately for the rural, suburban, and urban samples. The first row shows, for each sample, the average % correct for second-graders on the test described in Section 2.2; below that mean is the standard deviation for the group. Note how much better the urban children did than the rural ones, but, too, that the increment in performance of urban children over the others is being erodec as children remain longer in school (row 3).

The "effect size" is reported in row 4. This measure is, simply, the increment of third over second grader's scores divided by the standard deviation in second graders scores; dividing by the standard deviation allows (some) comparability across interventions, grade levels and environments and, for this reason, is increasingly widely used as a way of reporting educational impact. (Lockhead & Hanushek, 1988, report effect size measures for a broad range of educational interventions.) The effect sizes reported in row 4 are substantial--clearly showing substantial student cognitive improvement associated with additional schooling.

Table 3.1:

The Effect of One Year of Schooling

		Rural	Suburban	Urban	Total Sample
1.	2nd Grade Mean (%)	16.5	17.5	31.0	22.5
2.	2nd Grade S.D.	8.5	14.5	15.5	13.5
		***	***	***	***
3.	Increment of 3rd Over 2nd Grade Score	23.5	31.0	16.5	23.5
4.	Effect Size	2.8	2.1	1.1	1.7

3.2 The Effect of the REP

Table 3.2 shows the effect of the REP for both second and third graders in all three educational environments. The base score (in row 1) is the control school mean; row 3 reports the increment in % correct of the REP schools over the radio schools; and, again, row 4 reports effect sizes. Findings from the third-grade suburban schools are anomalous in being only very slightly positive; effect sizes averaging .9 are very substantial indeed. Another way of putting this, is observe that increasing educational quality (by introducing the REP) provides an increment in achievement over 50% of what a year of schooling provides, i.e., it is increasing the rate of learning by a remarkable 50%.

Table 3.2:

The Effect of REP

	Rural		Suburban		Urban		Total Sample	
	2nd	3rd	2nd	3rd	2nd	3rd	2nd	3rd
1. Control School Mean (%)	16.5	40.0	17.5	48.5	31.0	47.5	22.5	46.0
2. Control School S.D.	8.5	15.0	14.5	17.0	15.5	20.0	13.5	17.5
	***		***		***		***	
3. Increment of REP Over Control Score	17.5	19.0	13.5	0.5	8.5	26.5	12.5	15.5
4. Effect Size	2.1	1.3	0.9	0.03	0.5	1.3	0.9	0.9

4. ASSESSING COSTS

The REP's cost structure reflects, principally, incremental costs to those of the ongoing system of primary education. However, since the REP takes place within the regular classrooms, and requires the availability of the regular teachers, the total costs of REP must also include those costs. This section begins with a very brief assessment of the costs of the ongoing system then turns to assessment of the incremental costs of REP. The section then concludes with estimates for the costs of nationwide expansion of the REP.

4.1 Costs of Traditional Instruction

In Annex 1, Table EE provides an assessment of the cost of primary education in Bolivia. In summary, per student annual salary costs (teacher and administration) come to about $35; non-salary recurrent costs come to about $9; and (annualized) capital costs come to about $20. The total per student annual costs are, then, about $64. (Capital costs are annualized throughout this report at a 7.5% rate of interest with an appropriate estimate of the lifetime of the capital.)

Bolivian schools typically operate on a schedule of 25 periods per week for a cost, given the above, of about $2.60 per year for one period per week. Traditionally, mathematics instruction is allocated six periods per week for a pro-rated cost of $15.60 per year. The REP provides mathematics instruction in only 5 periods per week for a cost of $13 per year plus the incremental cost of the radio instruction. The important point to note is that the transition from traditional to radio based mathematics instruction frees up one period per week.

4.2 Costs of the REP

To a reasonable first approximation, the incremental costs of educational technology systems can be divided into those that are fixed independently of the number of students (F) and those that vary directly with the number of students(V). (Jamison [1977] provides a description and application of methodologies for costing educational technology systems, including a fuller description of fixed and variable costs.) The total annual cost TC(N), of serving N students per year is, then, in this formulation:

$$TC(N) = F + VN.$$

The average cost per student, AC(N), is simply the total cost divided by the number of students, i.e.:

$$AC(N) = TC(N)/N = F/N + V.$$

To put this slightly differently, the average cost is simply the cost directly associated with serving each student (V) plus each student's share of the fixed costs (F/N)

Tables AA, BB, CC, and DD in Annex 1 provide detailed information on the various components of the fixed and variable costs; the results from those tables are summarized in Table 4.1 on the following page. (Note that both fixed and variable costs can, in principle, have both capital and recurrent components, although in the way the REP cost analysis is structured, there are not fixed recurrent costs, as indicated by the 0 in the relevant entry of Table 4.1.) Capital costs must be "annualized" to put them into their annual equivalent terms--think of annual mortgage payments as the annualization of the value of a mortgage loan--and this has been done in Table 4.1. As with the annualization of school construction costs reported in Section 4.1, we use a 7.5% interest rate and an appropriate estimate for lifetime of the capital being.

In the REP the main fixed cost is the capital cost of lesson preparation; somewhat less important are project start-up costs. Something over $1.1 million is the estimated cost for preparing 540 lessons, resulting in a cost of about $2100 per 30 minute lesson (Annex 1, Table CC). Assuming a 15 year lifetime for the lessons and start-up activity, the annualized costs for these items is $140,000 per year, as indicated in Table 4.1. Radio receivers constitute the main variable capital cost and, assuming a 5-year lifetime for the receivers, the annualized receiver cost comes to about $.11 per student per year. Variable recurrent costs are estimated to come to $.70 per student per year.

These figures from Table 4.1 allow us to be specific about the total cost function for the REP:

$$TC(N) = \$140,000 + \$.81\ (N).$$

Table 4.1:

Summary Cost Table

Capital/Recurrent Category	Fixed/Variable Category	
	Fixed (F)	Variable (V)
Capital[a]	$140,000 per year for annualization of start-up and lesson preparation costs. (These costs are sunk as of December, 1991.)	$12 per year per receiver, for receiver costs of $.11 per student per year.
Recurrent[b]	0	$.70 per student per year to cover the costs of radio transmission, receiver power, teacher guides and student materials, teacher training, and supervision and administration.

[a]For detail on capital costs, see Annex 1, Tables AA, BB, and CC.

[b]For detail on recurrent costs, see Annex 1, Table DD.

Table 4.2 shows the values for total and average cost of the REP for a range of values of N. For the estimated 1991 enrollment of 70,000, total cost is $197,000 (= 140,000 + .81 x 70,000), and the average cost is $2.80 per student. Because the fixed costs are spread over far more students at the nationwide implementation level of 600,000 students, per student costs fall to $1.04.

Table 4.2:

Variation in Total and Average Annualized Costs (Including Start-up and Lesson Preparation Costs) with Student Usage

Number of Students (N)	Total Annualized Cost	Average (per Student) Annualized Cost
25,000 (1990 actual)	$160,000	$6.40
70,000 (1991 est.)	197,000	2.80
150,000	262,000	1.74
300,000	383,000	1.28
600,000 (all-Bolivia)	626,000	1.04

It should be remembered that this $1.04 is only the incremental cost of adding the REP; in addition, the estimated $13 cost per year for classroom and teacher (from Section 4.1) must be added to get the total cost of $14.04. This total cost is still less than that for traditional mathematics instruction ($15.60) because traditional instruction requires six periods per week rather than five.

4.3 Costs of Nationwide Expansion

The ongoing developmental phase of the REP comes to a close late in 1991. The product of that effort will be lessons and teachers' guides for radio mathematics in grades 2 through 5 as well as well-developed experience with implementation structures (including teacher training and supervision) for reaching large numbers of geographically dispersed students. The REP will, then, by 1992 be ready for nationwide implementation, and the Ministry of Education and Culture has expressed its interest in moving to national implementation at that time.

The costs of lesson preparation and start-up are no longer relevant from the perspective of national expansion, since those costs will, by then, have been sunk. The main relevant cost ingredients are the recurrent cost estimates (from Annex 1, Table DD) and the costs of receivers. Given an assumed pace of national implementation, one can use the available information on costs to generate an estimate for the cost of national implementation; Table 4.3 provides such an estimate.

The estimates in Table 4.3 assume only a slight expansion in coverage between 1991 and 1992 (from 70,000 to 100,000) but rapid expansion in the following two years, then a tapering off. On this schedule, virtually all of the (by then) 700,000 students in grades 2 through 5 would be served. The estimated cost for the 5-year program is about $2.5 million, including a "contingency" estimate of 20%. About 29% of the costs are for the students' notebooks and pencil, leaving a cost of $1.8 million to be centrally financed. (Receivers and batteries, about 20% of the cost total, could be financed at the school level, although as national implementation will be reaching more remote and poorer areas there is a case that these expenses, too, should be centrally covered.)

Table 4.3:

Costs of National Implementation, 1992-1996[a]

Usage	1992	1993	1994	1995	1996	Totals Amount	Totals %[b]
1. Students Served (thousands)	100	350	600	700	700	2450	
Costs (thousands of dollars)							
1. Radio transmission	35	35	45	45	45	205	10%
2. Radio receivers[c]	24	120	120	48	20	332	16%
3. Batteries (for 50% of receivers)[c]	45	13	24	28	28	97	4%
4. Mainline Power (for 50% of receivers)[c]	.5	1.5	2	3	3	10	0%
5. Teachers' Guides	0	20	14	7	20	61	3%
6. Teacher Training	14	50	85	100	100	349	17%
7. Supervision and Administration	18	65	110	125	125	443	21%
8. Student Notebooks[d]	25	90	150	175	175	615	29%
Subtotal	116.5	394.5	550	531	516	2112	100%
Contingency (at 20%)	23.5	78.5	110	106	103	422	
Total	**140**	**473**	**660**	**637**	**619**	**2534**	

[a]This table gives cost estimates based on the unit cost assumptions described in Annex 1, Tables AA and DD, the equipment lifetimes described in those tables and the pace of implementation indicated in row 1 of this table. Slight adjustments have been made where appropriate and there has been some rounding.

[b]The figures in this column indicate the % of the subtotal, excluding contingency.

[c]During the project development phase (1987-91) these costs have been covered by the local school or community.

[d]During the project development phase (1987-91) this cost has been covered by the students' families.

If external finance were sought, it would be reasonable for it either to cover the foreign exchange costs (including expenditures for potentially tradeable goods) plus some or all of local costs. About half of items 6 and 7 of Table 4.3 could be considered tradeable in that they involve fuel and transport plus some materials; virtually all of items 1 through 5 are tradeable. Thus about $1.3 million of the costs not borne directly by the students involve foreign exchange (or tradeable goods) costs, and the remaining $.5 million are strictly local costs which might or might not be suitable for external finance.

5. CONCLUSION: THE COST-EFFECTIVENESS OF REP

The preceding two sections have delineated this evaluation's finding concerning the effectiveness (Section 3) and the cost (Section 4) of the REP's implementation of interactive radio for mathematics instruction in grades 2-5 in Bolivia. This final section concludes by bringing the cost data together with the effectiveness data to provide an overall assessment of cost-effectiveness.

To set the context for the discussion of cost-effectiveness, two general observations are relevant. First, the finding of an effect size of .9 for one year of implementation of REP places the effectiveness of interactive radio's implementation in Bolivia at the top of the range of what has been achieved. The finding reported here is consistent with results from previous summative evaluations of the Bolivian REP (Section 1.4), which also show, significantly, that gains continue over at least two years of implementation (with effect sizes around 2 for that period). Second, although REP costs are very much within the range of cost experience with other implementations of interactive radio, they do also fall within the high side of that range. (See Tilson, 1990, for summarization of other finds on costs.)

Most previous assessments of the cost-effectiveness of interventions to improve quality of education in developing countries formed the ratio of incremental effectiveness to incremental cost; Lockhead and Hanushek (1988) refer to this ratio as the "efficiency" ratio when incremental effectiveness is measured in units of effect size and incremental cost in terms of dollars per student per year. Providing textbooks, according to the findings of Lockhead and Hanushek, results typically in a very attractive efficiency ratio of about .2 effect size units per dollar per year; in one exceptional example, in the Philippines, the gain was almost 1.5 per dollar. Most other interventions reviewed were less cost-effective except for interaction radio, which had cost effectiveness in the .3 to 1.3 range. Assuming, for the Bolivian REP, an effect size of .9 (Table 3.2) and an incremental cost per student per year of $.81 (Table 4.1), we obtain an efficiency estimate of 1.1 units of (incremental) effect per dollar per student per year. This, in the range of available alternatives, is extremely attractive--despite the relatively high cost environment that the Bolivian terrain imposes.

By assessing the effect size associated with a year of traditional instruction in Bolivia this evaluation was also able to weigh the cost-effectiveness of the REP against that of traditional instruction. Here total costs must be weighed against total learning gains. Section 4.1 estimated that the annual cost of providing traditional mathematics instruction for the scheduled 6 periods per week was about $15.60. The total annual cost of the REP is equal to its incremental cost

of $.81 plus the cost of teacher and classroom for its scheduled 5 periods per week; this total is about $13.80 per year. From Table 3.1, we estimate an effect size for traditional instruction of about 1.7 per year (across all locales tested); this results in a ratio of .11 for total efficiency (i.e. total gain in achievement divided by total cost). For the REP the total achievement gain is about 2.6 (=1.7 + .9) and the total cost is $13.80 per year for a total efficiency ratio of .19. The cost-effectiveness of mathematics instruction in Bolivia using the REP is, therefore, about 70% higher than the cost-effectiveness of traditional instruction. The efficiency arguments for switching to REP is, therefore, very strong; and, in Section 4.3, the cost (over 5 years) of making the transition nationwide was estimated to be about $2.5 million.

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Annex 1: DETAILED COST TABLES

This annex provides background information on costs that forms the basis for the costs estimates used in the text. Although the tables include approximations and estimates, and alternative classifications are possible, they do provide a reasonable first approximation to the cost experience of the project.

The subjects of the Tables are:

Table AA: Radio Mathematics Resource Use-Capital Costs
Table BB: Start-up Costs
Table CC: Costs of Lesson Preparation
Table DD: Radio Mathematics Resource Use-Recurrent Costs
Table EE: Costs of Traditional Primary Education
Estimates in 1980.

Table AA: Radio Mathematics Resource Use - Capital Costs

Cost Item	Lifetime (yrs)	Cost	Annualized Cost (at 7.5% interest rate)
1. Fixed Capital Costs			
1.1 Startup Costs (See Table BB)	15	$ 107,000	$ 12,000 per year
1.2 Lesson Preparation (540 lessons at average cost of $ 2100 per lesson, See Table CC)	15	$ 1,135,000	$ 128,000 per year
2. Variable Capital Costs			
2.1 Receivers (one per 3 classrooms)[a]	5	$ 50	$ 12 per year

a) In some regions, beginning 1991, one radio will be shared by children in four grades, as the radio programs are broadcast at different times. In other regions, two grades may be broadcast simultaneously, one on AM and one on FM, therefore limiting access to the radio to any two parallel grades at a time. For this reason, we are using an average of 3 classrooms per radio for this estimate.

Table BB: Start-up costs

Cost Item	Amount
1 Month salary & benefits, COP	$ 5,078
1 Month relocation, COP & family	2,640
Transportation San Francisco-La Paz	3,200
Ship household effects & auto	33,000
1 Month storage	150
Accompanied Baggage	1,800
Communication	600
Local staff	4,000
1 Month office rent (provided in kind)	500
Supplies	300
Resource Materials	1,000
Local Travel	700
	52,968
O/H @ 35%	18,539
Furniture Package	35,000
Total	$ 106,507

Table CC: Costs of Lesson Preparation [a]

	Cost Item	Cost, 1987-90 (projected through 1990)
1.	Studio Capital Costs	$ 45,000
2.	Office and Studio Rent	39,700
3.	Vehicle Capital	-none-
4.	Operating Expenses	
	4.1 Travel	160,400
	4.2 Fuel & Rental Cars	4,000
	4.3 Off Supplies (& Off Furn, & Equip, and printing)	48,200
	4.4 Recording supplies	27,000
	4.5 Consultants	38,000
	4.6 Communications	20,200
	4.7 Utilities & Maintenance	17,000
	4.8 Mtls Shipment	6,000
	Subtotal	320,800
5.	Staff Costs	
	5.1 Studio	81,400
	5.2 Evaluation	65,500
	5.3 Curriculum Writing	125,600
	5.4 Administration (T.A.)[b]	304,000
	5.5 Administration (Other)[c]	153,000
	Subtotal	729,500
TOTAL COSTS		$ 1,135,000
Number of Lessons	130/year 2nd & 3rd = 260 140/year 4th & 5th = 280	540
Cost Per Lesson		$ 2,100

a) To complete all 540 lessons.

b) This covers 28 months of long-term technical assistance spread over a 38 month period. Salary, benefits, housing allowance and overhead are included.

c) This includes a portion of the Project Director's time plus that of the administrative office and assistant, secretaries, messengers, guards, etc.

Table DD: Radio Mathematics Resource Use - Recurrent Costs

Cost Item	Unit Annual Cost	Number of Students Served per Unit	Annual Costs Per Student Served
1. Radio transmission	$ 1850 Transmitter to broadcast for 4 grades.	26,000	$ .07
2. Receiver power (50% of receivers assumed to use batteries at ten times the cost of mainline power) power)	$ .25 per battery (5 sets of 6 batteries used per radio or per 105 students per year) or 35 batteries per student p.a.	Approx. 6 students per battery, assuming 50% of students' receivers use mainline power.	.04
3. Teachers' guide	$ 2 each, lasting three years or $ .70 per year	35	.02
4. Teacher training	Average of 1.25 days per teacher per year at a cost of $ 5 per year (currently provided by release time)	35	.14
5. Supervision & administration	9 supervisors and 1 administration per Department, annual cost of $12,000 including transport.	67,000	.18
6. Student notebooks and pencils (incremental)	$ .25	1	.25
TOTAL			$ .70

Table EE: Costs of Traditional Primary Education, 1990

	Cost Item	Annual per Student Cost
Recurrent Costs		
1.	Teacher costs (assumes 33 students per teacher and teacher pay of $ 925. per shift per year)	$ 28
2.	Administration costs (assumed to be 25% of teacher costs)	7
3.	Student fee (to cover textbooks and discretionary school expenses)[a]	3
4.	Notebooks, pencils and school uniform [a]	5
5.	Chalk and other supplies	1
	Subtotal	$ 44
Capital Costs		
1.	Construction (based on estimates [b] of urban constructions of $ 145/m2, that an urban classroom serves 60 children in two shifts, that the classroom and its share of common space takes 70 m2, that rural per student costs are 25% higher than urban [b], that 50% of students are rural, that land costs add 10% and that construction costs are annualized over 40 years at 7.5%)	$ 17
2.	Furniture (assumes one 2-child desk costs $46 [b] and that costs are annualized over 10 years at 7.5%)	$ 3
	Subtotal	$ 20
	Total	$ 64

a) These expenses are born by the students' families.
b) CONES (n.d.) provides a review of furniture and construction costs for schools in Bolivia; see "Políticas de Edificaciones Escolares Gestion: 1989-1993".

Annex 2: INSTRUMENTS

PRUEBA COCHABAMBA, 2DO Y 3RO BASICO-PLANTILLA PARA EL MAESTRO

Queridos niños, hoy vamos a hacer algunos ejercicios de matemática, ustedes tienen en su banco las hojas con ejercicios; todos empezaremos a trabajar juntos. No olviden que deben trabajar solos , no miren las hojas de sus compañeros.
Tomen su lápiz , donde dice nombre y apellidos escriban sus nombres y apellidos.
(PAUSA 40 SEG.)
Muy bien, vamos a trabajar, fíjense donde esta el ejercicio No.1, ejercicio No.1
(PAUSA 3 SEG) ahí dice: Escribe el número.....(ESPERAR LA PAUSA INDICADA, LUEGO PASAR AL OTRO EJERCICIO) Pasamos al ejercicio No. 2, ejercicio No. 2... Encierra.....

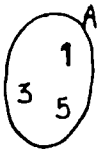
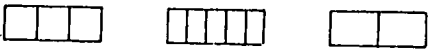
1 Escribe el número Quince sobre la raya. Repito: Ecribe el número QUINCE sobre la raya _____ (PAUSA-10 SEG)	11 Carlos comió 4 duraznos y más tarde comió 3 duraznos y su amigo Luis comió 5 duraznos ¿cuántos duraznos comieron el total? _____ (PAUSA-25 SEG)
2 Encierra en un círculo la cantidad menor. 14 37 29 (PAUSA-20 SEG)	12 ¿Cuánto es SETENTA menos SESENTA? Sobre la raya, escribe solo el resultado Repito: ¿Cuánto es SETENTA menos SESENTA? Sobre la raya, escribe solo el resultado. _____ (PAUSA-15 SEG)
3 Anota entre las llaves los elementos del conjunto A A = { } (PAUSA-20 SEG)	13 ¿Cuánto es QUINIENTOS menos CIEN? Escribe sobre la raya, solo el resultado. Repito: ¿cuánto es QUINIENTOS menos CIEN? Sobre la raya, escribe solo el resultado? _____ (PAUSA-15 SEG)
4 Realiza este ejercicio: 7 + 3 = (PAUSA-15 SEG)	14 José compra plátanos a 3 Bs, le da 10 Bs al vendedor, ¿cuánto recibirá de cambio? _____ (PAUSA-30 SEG)
5 Escribe el número que va después 71 _____ (PAUSA-15 SEG)	15 ¿Cuánto es 4 x 2 x 3? _____ (PAUSA-30 SEG)
6 Escribe el número que va después 4.529 _____ (PAUSA-20 SEG)	16 Celia tiene 8 lápices para repartir a sus 4 hijas. ¿Cuántos lápices recibirá cada hija? _____ (PAUSA-20 SEG)
7 Escribe el número que va antes _____ 410 (PAUSA-20 SEG)	17 Encierra en un círculo el dibujo que está dividido en MEDIOS. (PAUSA-15 SEG)
8 Encierra en un círculo la cantidad mayor. 923 479 150 (PAUSA-15 SEG)	18 Encierra en un círculo la fracción mayor $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{5}$ (PAUSA-10 SEG)
9 Sobre la raya, escribe con números DOSCIENTOS TREINTA Y SIETE. Repito: Sobre la raya, escribe con números, DOSCIENTOS TREINTA Y SIETE. _____ (PAUSA-10 SEG)	19 Sobre la raya, escribe el número mixto TRES DOS TERCIOS. Repito: Sobre la raya escribe el número mixto, TRES DOS TERCIOS. _____ (PAUSA-35 SEG)
10 ¿Cuánto es OCHOCIENTOS MAS VEINTICINCO? sobre la raya, escribe el resultado. Repito: ¿cuánto es OCHOCIENTOS MAS VEINTICINCO? sobre la raya, escribe el resultado._____ (PAUSA-25 SEG)	20 Encierra en un círculo el número mayor 2 0,8 (PAUSA-10 SEG)

MUY BIEN NIÑOS, AHORA VOLCAMOS LA HOJA (PAUSA-3)

Ahí tienen tres columnas de ejercicios, columna A, B y C. Deben hacer todos esos ejercicios; primero hacen de la columna A, después de la columna B y finalmente de la columna C. Empiecen a trabajar niños. (PAUSA- 25 MINUTOS).

COLUMNA A	COLUMNA B	COLUMNA C
21 504 + 132	29 43 x 6	37 212 x 4
22 73 + 6 =	30 6 __2__	38 826 x 7
23 64 + 28	31 895 + 7	39 4.375 x 4
24 376 - 56	32 8.720 + 7.953	40 35 __7__
25 82 - 59	33 392 + 67 482	41 48 __6__
26 32 x 3	34 7.533 - 2.020	42 78 __5__
27 6 x 0 =	35 546 - 127	43 6,93 + 1,51
28 91 x 2	36 425 - 279	44 6,9 + 6,7

Nombre y Apellidos: _____

1 _____	11 Carlos comió 4 duraznos y más tarde comió 3 duraznos y su amigo Luis comió 5 duraznos, ¿cuántos duraznos comieron en total? _____
2 Encierra en un círculo la cantidad menor. 14 37 29	12 _____
3 Anota entre las llaves los elementos del conjunto A  A = { }	13 _____
4 Realiza este ejercicio: 7 + 2 =	14 José compra 3 Bs. de plátanos, le da 10 Bs. al vendedor. ¿Cuánto de cambio recibirá? _____
5 Escribe el número que va después 71 _____	15 ¿Cuánto es 4 x 2 x 3? _____
6 Escribe el número que va después 4.529 _____	16 Celia tiene 8 lápices para repartir a sus 4 hijas. ¿Cuántos lápices recibirá cada hija? _____
7 Escribe el número que va antes _____ 410	17 Encierra en un círculo el dibujo que está dividido en MEDIOS. 
8 Encierra en un círculo la cantidad mayor. 923 479 150	18 Encierra en un círculo la fracción mayor $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{5}$
9 _____	19 _____
10 _____	20 Encierra en un círculo el número mayor 2 0,8

MUY BIEN NIÑOS, AHORA VOLCAMOS LA HOJA.

COLUMNA A	COLUMNA B	COLUMNA C
21 $504 + 132$	29 43×6	37 212×4
22 $73 + 6 =$	30 $6 \mid 2$	38 826×7
23 $64 + 28$	31 $895 + 7$	39 4.375×4
24 $376 - 56$	32 $8.720 + 7.953$	40 $35 \mid 7$
25 $82 - 59$	33 $392 + 67 + 482$	41 $48 \mid 6$
26 32×3	34 $7.533 - 2.020$	42 $78 \mid 5$
27 $6 \times 0 =$	35 $546 - 127$	43 $6,93 + 1,51$
28 91×2	36 $425 - 279$	44 $6,9 + 6,7$

CUESTIONARIO PARA ALUMNOS

A) Nombres y Apellidos: _____

B) Edad: [ ]

C) Sexo:
- [0] Mujer
- [1] Varón

CH) Repite el curso:
- [1] Sí
- [0] No
- [ ] No se

D) Idioma que habla en su casa:
- [0] Castellano
- [1] Quechua

E) Llevó matemática Radial en 2o, el año pasado?
- [1] Sí
- [0] No

F) Tiene texto escolar?
- [1] Sí
- [0] No

G) Con quién vives?
- [1] Papás
- [2] Tíos
- [3] Abuelos
- [0] Otras personas, hermanos

H) Quién te ayuda a hacer tus tareas?
- [1] Papás
- [2] Tíos
- [3] Hermanos
- [4] Otras personas
- [0] Nadie

I) En qué vienes a la escuela?
- [1] Micro
- [2] Bicicleta
- [3] A pie
- [0] Otras formas

J) Cuántos hermanos tienes? [ ]

K) Tu papá sabe leer y escribir?

1	Sí
0	No

L) Tu mamá sabe leer y escribir?

1	Sí
0	No

LL) Donde trabaja tu papá?

0	No trabaja
1	Siembre y cosecha
2	Fábrica (obrero, albañil, capintero, zapatero, mecánico)
3	Empleado público, oficina
4	Profesor
5	Comerciante, vendedor
6	Otros, chofer, boletero, sereno, músico, cerámica.

M) Donde trabaja tu mamá?

0	Labores de casa (no trabaja)
1	Siembra y cosecha
2	Fábrica (obrero)
3	Empleada doméstica
4	Vendedora, comerciante
5	Otros, lavandera, sereno

DATOS PARA OBTENER DE REGISTRO

N) Fecha de Nacimiento [ ]

Ñ) Cuántos días faltó a clases hasta el 20 de agosto? [ ]

P) Idioma que habla en su casa

0	Castellano
1	Quechua

R) Cuántos días de trabajo cumplidos hasta el 20 de agosto? [ ]

HOJA CLAVE PARA CODIGOS, TOMAR DATOS (Cochabamba 1990)

AA, ESCUELA:

1	VISCARRA
2	MAYOR USTARES
3	MARISTAS
4	JESUS MARIA
5	CUARTO CENTENARIO
6	GUILLERMO URQUIDI
7	SANTA LUISA DE MARILLAC
8	EL SALVADOR
9	VALLE HERMOSO CENTRAL
10	PACATA ALTA
11	HUMBERTO PORTOCARRERO
12	CRISPO ANAYA

AB) ZONA [1] urbana [2] suburbana [3] rural

AC) GRUPO [1] con radio [0] sin radio

AD) CURSO [2] segundo [3] tercero

AE) SECCION [1] (2A - 3A) [2] (2B - 3B) [3] (3C - 3C)

AF) NOMBRES Y APELLIDOS DEL PROFESOR _____

AG) EDAD [ ]

AH) CATEGORIA [ ]

AI) AÑOS DE SERVICIO [ ]

AJ) TITULO BACHILLER: [1] Si [0] No

AK) TITULO MAESTRO [2] Normalista [1] Titular antiguedad [0] Interino

AL) TITULO UNIVERSITARIO [1] Si [0] No

ALL) IDIOMAS QUE HABLAN [0] Castellano [1] Quechua [2] Otro

AM) TOMA SU DIA LIBRE SEMANAL [1] Si [0] No

AN) CONQUIEN PASAN MAT. RADIAL ESE DIA SUS ALUMNOS? [0] Nadie [1] Conmigo [2] Solos

CUESTIONARIO DATOS ESCUELA, PROFESOR Y ALUMNO 1990

AA	AB	AC	AD	AE	AF) Nombres y apellidos del profesor	AG	AH	AI	AJ	AK	AL	ALL	AM	AN

Datos para preguntar al alumno.

Datos para obtener de los registros.

No.	A)Nombre y Apellidos	B	C	CH	D	E	F	G	H	I	J	K	L	LL	M	N	Ñ		P	R		

LA FAMILIA DE LOS NUMEROS

A COST STUDY

Honduras

September, 1990

EVALUATION OF DEVELOPMENT AND RECURRENT COSTS FOR "LA FAMILIA DE LOS NUMEROS" TEGUCIGALPA, HONDURAS

Contract No. DPE-5818-C-00-5059-00 USAID/Honduras

BY

DEVELOPMENT TECHNOLOGIES, INC.

UNDER SUBCONTRACT TO

EDUCATION DEVELOPMENT CENTER, INC.

SEPTEMBER 1990
WASHINGTON, D.C.

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EXECUTIVE SUMMARY

This report is a cost study conducted during September, 1990, for USAID/Honduras related to the Radio Mathematics Learning Project in Honduras entitled "La Familia de los Numéros." Data collection and analysis were carried out in Honduras by Ms. Patricia Godoy-Kain from September 4-25, 1990. The cognizant USAID/Honduras technical representative emphasized that the focus of this effort was to provide the Mission with a summary of investments made to date to develop the program and the funds required to continue its implementation. In order to assess the program's future funding requirements, costs for the initial four years were analyzed to provide the basis for projecting three years forward. Future cost-effectiveness ratios were then calculated on the basis of these projections.

For the purposes of this analysis, "development" cost is defined as the combination of development and implementation costs, from the inception of the Project in 1987 through 1990, that is, total investment to date. Recurrent costs were analyzed to estimate yearly expenditures required to maintain the program for the next three years (1991-1993) under different levels of administrative and technical personnel. Separate and apart from these projections, alternative calculations of costs were made including prorata amortization of the initial investment, plus a factor for opportunity cost (or social discount rate) at a 17% rate of interest.

Before presenting any cost figures, it is important to note how this report presents costs in US dollars as a consequence of a recent significant devaluation of the Lempira. During all but the last few months of the development phase of this project beginning in 1987, the exchange rate was approximately 2 Lempiras per dollar. Beginning in January, 1990, the Lempira began to be devalued, reaching 5.5 Lempiras per US dollar by mid-September. Thus, the development costs of the project will be stated in terms of predominate existing exchange rate at that time of US $1 = 2 Lempiras. The recurrent costs, however, will be stated using two rates, both 2 Lempiras per dollar and 3.4 Lempiras per dollar. The 3.4 rate is calculated using a combination of two rates; the rate of 5.5 Lempiras per dollar is applied to costs not tied to imported goods, and a rate of 2 Lempiras is applied to items that must be imported and, thus, be paid in dollars. If only a single dollar value is given in this report, the exchange rate is 2 Lempiras per dollar; if two dollar figures are given, the second figure will be at the 3.4 rate and will be in parenthesis.

During 1987-90, there was a total expenditure of $6,930,000 Lempiras or US $3,465,00. These expenditures included development of 465 twenty-seven minute lessons for first through

third grades and implementation costs to expand the program throughout the country with a 195,682 students participating in 1990, and cumulative total of 344,278 students. Tables 1, 2 and 3 in Annex I present the detailed line items of expenditure for each of the four fiscal years.

The full development costs should also include opportunity costs, that is, costs that are associated by not using the funds for some alternative purpose. For example, if the funds were placed into an account of a Honduran bank, they could have earned 17% interest. Thus, the full cost, including the opportunity costs, is 8,418,728 Lempiras or US $4,209,364.

For the period 1991-1993, projected recurrent expenditures were calculated under three scenarios considering different levels of administrative and technical personnel. Scenario A is the most expensive option and reflects a continuation of the current staffing levels with the capacity to create new programs as well as to revise previously developed lessons; Scenario B is based on a reduced capacity, but would be sufficient enough to revise the lessons in grades 1 and 2; Scenario C provides only enough support to sustain the radio lessons in the schools. The table below provides details for each scenario. Annex I presents the details of annual recurrent expenditures associated with the three scenarios, which are summarized in Section III of this report.

TOTAL RECURRENT COST FOR 1991-1993

	Scenario A	Scenario B	Scenario C
No. Admin. Personnel	6	2	1
No. Tech. Personnel	17	9	4
Total Personnel	23	11	5
Total Cost 1991-93 ('000 Lempiras)	3,515	2,635	2,179
Less: Donated Radio Air Time	(919)	(919)	(919)
Net Amount to be Funded	2,596	1,716	1,259
Details of Net Amount to be Funded:			
AVANCE Adm. Charge	290	218	180
Salaries & Fringe	1,208	710	418
Travel	260	110	74
Other	249	128	99
Studio Operations	62	62	
Instructional Material	527	488	488
Total Lempiras	2,596	1,716	1,259
Less:(a) Revenues from Sale of Packages	(224)	(224)	(224)
Net Lempiras	2,372	1,492	1,035
US Equivalent (Exch. US $1 = 2 Lempiras)	1,186	746	517
(Exch. US $1 = 3.4 Lempiras)	698	219	152

(a) Assumes a 60% recovery of the total value of packages sold

Using the total recurrent costs, e.g. not backing out the donated time for the transmission of the lessons nor the revenues from the sale of the packages, the recurrent cost per student under Scenario C is 3.06 Lempiras or $1.53 ($0.90). To maintain a staff for revising the lessons (Scenario B) would result in a recurrent cost per student of 3.78 Lempiras or $1.89 ($1.11), and to maintain the existing staff to develop new programs would result in a recurrent cost per student of 5.04 Lempiras or $2.52 ($1.48).

The projected recurrent cost per student can be compared to

the per student recurrent government expenditures. The latest figure in 1988 is 285 Lempiras per primary school student; assuming a growth rate of 15% to 1991, the total government per primary school student would be 328 Lempiras. The Honduran radio education program for mathematics is not designed to replace the current math curriculum, but to reinforce it. This add-on cost in 1991 Lempiras to maintain "La Familia de los Numéros" ranges between 0.09% and 1.5% of the annual per student recurrent government expenditures for primary education.

This paper also includes a measure of educational efficiency, or cost-effectiveness, which is the ratio of incremental achievement gains as measured by the effect size, per US $1 of incremental cost. Using an average effect size for the two grades of .49, and a recurrent cost of US $1.53 ($0.90) for 1991, the cost-effectiveness ratio is .32 or .54 with an exchange rate of 3.4 Lempiras per dollar.

Finally, the paper presents the total average annual cost of the radio series assuming ten-year life for the radio math series. This figure is the sum of the annual recurrent costs, plus the development costs annualized over a ten year period and adjusted for the opportunity costs at 17%. Based on Scenario C for the three years 1991-93, the total cost is 4,628,438 Lempiras or US $2,314,219; this is 6.50 Lempiras US $3.25 ($1.91) per student assuming a total of 712,500 students. See the discussion in Section V and Table 8 in the Annex.

INTRODUCTION

The Association for Socio-economic Promotion and Development (AVANCE) is a Honduran private organization through which the United States Agency for International Development (AID) has funded the development of the radio interactive project "La Familia de los Numéros." This report calculates project development costs, recurrent costs and cost-effectiveness ratios of the project as administered by AVANCE.

Section I gives a brief description of AVANCE as a private organization and its role in the project "La Familia de los Numéros." It includes a description of goals and methodologies and the distribution of students and teachers participating in the program at the national level.

Section II presents development and implementation expenditures of the project during the 1987-90 period. Section III presents recurrent costs under the assumption that there will be transmission of lessons for first through third grades every year for the next three years and under different staffing assumptions.

Section IV presents estimated cost-effectiveness ratios and total costs. Total costs here include recurrent costs plus amortization and opportunity costs of developing and implementing "La Familia de los Numéros."

Section V presents the total average annual cost of the "La Familia de los Números" series, that is, the sum of the development costs, annualized over ten years and adjusted with a 17% opportunity cost, plus the recurrent costs.

Annex I shows a summary of tables used in this analysis. Annex II includes a brief description of the development phases. Annex III presents the results of evaluation of children's learning gains undertaken in 1988 and 1989 for first and second grades.

SECTION I. BACKGROUND INFORMATION

A. AVANCE

AVANCE is a Honduran private voluntary organization whose role is to promote and develop projects to improve the socio-economic conditions in Honduras. In 1986, the United States Agency for International Development USAID/Honduras initiated a broad-base effort for educational improvement. The proposed effort was sub-divided into several components. One of the components was interactive radio instruction. The radio component was placed under the control of AVANCE. At the time, a key reason for this was that the Honduran Ministry of Education considered that its personnel did not have the technical capacity

to undertake and implement an effective and efficient radio education pilot project.

AVANCE was a small established organization whose sole activity was a weekly publication of a rural development newspaper called El Agricultor. USAID considered AVANCE as a convenient home to introduce the private sector to public education and entered into a cooperative agreement with AVANCE effective March 4, 1987. This agreement specified that AVANCE would administer funds provided by USAID for the development of an interactive radio instruction series in mathematics for grades one through three. The series is called "La Familia de los Numéros."

B. "La Familia de los Numéros"

The purpose of the AVANCE project is to help children of the first three grades of primary school in their ability to do fast mental arithmetic operations. The goals of the project were:

a) to improve the quality of public education,
b) to improve the efficiency of public education,
c) for AVANCE to attain financial self-sufficiency, and
d) private sector institutional development.

The concepts of self-sufficiency and privatization in this project were new ideas in the history of interactive radio instruction. All previous pilot projects were public-sector educational interventions managed and housed in ministries of education.

Within AVANCE, Sistema de Educacion Interactiva (S.E.I.) was established as a special unit to develop and implement the radio mathematics program. AVANCE's board of directors and its General Manager were to be in charge of the administrative operations of the project.

S.E.I. started to research and produce the curricula for first grade mathematics in 1987. Transmission started in 1988. By the end of 1990, S.E.I. will have completed the production of the mathematics curriculum for first through third grades.

During the first year of the project, two basic packages of instructional material were available. These packages were sold to the teachers who wished to participate in the program. The packages consisted of the following materials:

Type A : 1 radio, 1 teacher guide, 4 posters,
1 workbook, 1 carrying bag

Type B : 1 teacher guide, 1 workbook, 4 posters,
1 carrying bag

The choice of package A or B was given to allow teachers to buy instructional material if they already had a radio. Second and third grade packages differ from first grade in that they do not contain the colored posters. Packages are sold to teachers through a regional supervisor who earns 10 Lempiras for each package A he/she sells. There is no commission earned for sales of package B. Package A has been sold to first grade teachers for 125 Lempiras or US $62.50. Package A for second and third grade has been sold to teachers for 115 Lempiras or US $57.5. Package B has been sold to all teachers for 10 Lempiras or US $5. The price of packages to teachers has been the same during the 1988-90 period. Considering the recent devaluation of the Honduran Lempira to 1 US $ = 5.5 Lempiras, future sales of package A, which includes a radio purchased with hard currency, will imply a loss to the project if they continue to be sold at the current price of 125 Lempiras.

In 1988, the first year of transmission, only first grade mathematics was offered. Second grade was added the following year and third grade started in 1990.

During the 1988-1990 period, the participation of teachers and students in the program increased continuously. Table 1.1. below shows the distribution of teacher and student participants at the national level.

The number of teacher participants in 1990 comprises 42% of total teachers in grades 1-3 in the nation in 1990 and the amount of student participants in 1990 comprises 34% of total students in grades 1-3 registered in 1990.

TABLE 1.1. TEACHERS AND STUDENTS IN 1ST, 2ND & 3RD GRADES PARTICIPATING IN "LA FAMILIA DE LOS NUMEROS"

	Grade 1	Grade 2	Grade 3	Combined
1988				
Teachers	1,815			1,815
Students	55,550			55,550
1989				
Teachers	2,237	902		3,139
Students	67,110	25,936		93,046
1990				
Teachers	2,498	2,446	1,092	6,036
Students	92,221	75,666	27,795	195,682
Total				
Teachers	6,550	3,348	1,092	10,990
Students	214,881	101,602	27,795	344,278

Source: AVANCE/S.E.I., Tegucigalpa, Honduras, Sept. 1990

SECTION II. CUMULATIVE INVESTMENTS - INCEPTION THROUGH 1990

A. Development Phase

The radio interactive instruction program "La Familia de los Numéros" has been developed and implemented over a four-year period (see Annex II for a full description of the Project's evolution).

The developmental stage of the project consisted of informational research, production and design of instructional material (i.e., lesson design, scriptwriting, teacher guides, student workbooks, radio production, transmission of lessons, evaluation of learning gains, and teacher training), and distribution of packages throughout the country to teacher and student participants. Development and implementation of a given grade level instruction program occurred simultaneously in the sense that the final preparation of individual lessons preceded actual airing on the radio by as little as one week. For example, although the third grade level was introduced in the 1990 school year, development of individual classes continues as of now.

Also part of the development process were the establishment of a network for the sale of the packages to the teachers through a supervisor, and establishing relationships between project staff and radio station owners who have donated the cost of transmission to the project.

B. Total Investment Expenditures

Total investment in this project, from inception through 1990 amounts to 6,930,952 Lempiras or US $3,465,476 (see Table 3 in Annex I). This number was arrived at by adding the expenditures for technical assistance provided by the Radio Learning Project through the Education Development Center (EDC), the Academy for Educational Development (AED), and Friend Dialogues (FDI), to the expenses of AVANCE. The data were provided by the three U.S. institutions and by the project management of AVANCE in Tegucigalpa. The latter required considerable reconciliation, interpretation and reclassification on the part of the contractor. This was accomplished by reviewing subsidiary records such as payroll registers, fixed asset lists and selected accounting reports, and extensive interviewing and reviewing with the Chief Administrator of AVANCE.

Based on this analysis, the total investment, including costs for developing the programs and implementing them on a national basis, is as follows:

TABLE 2.1. DISTRIBUTION OF TOTAL INVESTMENT COSTS
'000 LEMPIRAS

	1987	1988	1989	1990	TOTAL
DEVELOPMENT	739	1,101	1,481	643	3,964
IMPLEMENTATION	6	798	1,126	1,036	2,966
TOTAL	745	1,899	2,607	1,679	6,930

SOURCE: AVANCE, AED, EDC, and FDI
See Table 1 in Annex I.

Total investment costs can be viewed from a different perspective by recasting the costs by functional classification in the following manner:

TABLE 2.2 DISTRIBUTION OF TOTAL INVESTMENT COSTS BY CATEGORY
'000 LEMPIRAS

	1987	1988	1989	1990 (4)	TOTAL
ADMIN.PERS.	24	239	259	224	746 (1)
TECH.PERS.	118	207	235	234	794
OP/EQUIP.	153	733	1,230	928	3,044 (2)
TECH.ASSIST.	450	720	883	293	2,346 (3)
TOTAL	745	1,899	2,607	1,679	6,930

SOURCE: AVANCE/S.E.I. Honduras, Sept. 1990
See Table 2 in Annex I.
(1) Includes AVANCE's central administration expenses charged to the project.
(2) Includes instructional material such as: radios, teacher guides, workbooks, posters and carrying bags. It also includes donated air time costs.
(3) Fully loaded cost of short and long-term experts provided through USAID/Honduras funding.
(4) Salaries and related fringe benefits have been projected through December 31, 1990.

The source of funding for total investments can be summarized as follows:

TABLE 2.3. DISTRIBUTION OF TOTAL PROJECT INVESTMENTS
BY SOURCE OF FUNDS
'000 LEMPIRAS

	1987	1988	1989	1990	TOTAL
USAID/HOND	745	1,585	2,438	1,411	6,179
LOCAL BSNS a)		314	169	268	751
TOTAL	745	1,899	2,607	1,679	6,930
		PERCENTAGE SHARE			
USAID/HOND	100	81	92	84	89
LOCAL BSNS		19	8	16	11

Source: AVANCE/S.E.I., Honduras, Sept. 1990
a) Local business: air time cost (87-90), cost of posters and workbooks (88)

The contractor believes that the 6,930,953 Lempiras presented in the above tables is a fair reflection of total investments even though financial statements were not available to support the figures.

For those interested readers, Tables 1, 2, and 3, Annex I, provides detailed breakdown of the various line items of expenditures in support of Tables 2.1 and 2.2 above. These detailed tables provided the basis for the projections made in Section III related to the level of expenditures required to maintain the operations of the project for the 1991-1993 period.

The preceding figures reflect the actual investment costs. A full costing of the development costs, however, requires that an opportunity cost be included. The use of available funds for creating the "La Familia de los Números" was, theoretically, only one possible option. The money could have been used for other projects, or put into the bank to earn interest for future use. Therefore, an opportunity cost, sometimes referred to as a social discount rate, needs to be applied to the investment amount. Since Honduran banks were providing 17% interest during this period, a 17% opportunity cost is applied to the investment figure. The results are shown below:

	1987 - 1990	
	Lempiras	Dollars
Total expenditure	6,930,952	3,465,496
Total with opportunity cost	8,418,728	4,209,364

SECTION III. PROJECTED EXPENDITURES 1991-1993

A. Basic Assumptions

Future development investments are not considered in the following projections. These estimates assume that the radio mathematics program will continue at the same level of intensity and quality as in the 1987-90 period. The amounts do not include amortization of previous investments nor depreciation of existing fixed assets.

The structure within which expenditures have been projected is the same format as found in Table 1, Annex I, with the exception that technical assistance has been eliminated. The following categories remain:

a) administrative personnel,
b) technical personnel, and
c) operating expenditures.

Using the current 1990 expenditures, a basic static simulation analysis was performed considering three possible staffing arrangements:

Scenario A: Current staffing of 23 posts, 6 administrative and 17 technical. This would leave untouched the capabilities for continued project development

efforts, if the need arises. If no future development were to take place this staffing level would represent excess capacity.

Scenario B: Reduce current staffing to 11 posts, 2 administrative and 9 technical. This would substantially reduce capabilities for future development efforts, but it should be sufficient to make necessary revisions to lessons for grades 1-2.

Scenario C: Reduce staffing to the absolute minimum to maintain the current level of implementation and the planned expansion of the program, but it will not be able to make any changes to the lessons. Staffing of 5 posts, 1 administrator and 4 technicians.

To calculate salary increases, AVANCE's internal policy was followed. That policy is an annual inflation factor of 6% plus a 3% increase due to performance or productivity for the technical staff. Price increases for all other expenditures were calculated assuming a 6% annual inflation rate.

Operating expenditures such as travel, per diem, gasoline and vehicle repairs were assumed to be at the level of 1990 under Scenario A. Under Scenario B, operating expenditures were expected to decrease by at least 50% because lesson evaluations will be eliminated. To keep track of students' learning gains, tests would be given two or three times a year. Some travel and per diem would also be necessary to continue the distribution of packages to teachers willing to join the program.

Under Scenario C, travel and per diem expenditures were reduced further to 33% of expenditures in Scenario A since the team of five would only be able to distribute the material needed by new teachers joining the program and give some limited training to the new graduating teachers.

Expenditures for instructional material were calculated on the assumption that there would be an annual increase of student participants of 10% per year per grade.

Cost of packages to the teachers and supervisor's commissions were maintained at the level of 1990. Costs to teachers for package A were assumed to be 125 Lempiras for first grade and 115 lempiras for grades two and three. The price for package B was assumed to be 10 lempiras for all grades.

S.E.I.'s production coordinator believes that in 1991 first grade lessons should be reproduced. This is because of the inferior quality of the tapes used and the inferior quality of the content compared to second and third grade material.

The following year, a percentage of second grade lessons should be re-recorded. This will not require more than 200 tapes of 30 minutes.

Third grade lessons will not require reproduction or major re-recording in 1993 since tapes presently used are of superior quality. By 1993, a 100 tape inventory would be sufficient to cover losses or damage to tapes.

If transmission is maintained through three stations, there is no need for more than 50 tapes per year for transmission purposes alone. Recording costs only includes the cost of buying reel tapes to reproduce grade 1 lessons in 1991, to re-record 10% of grade 2 lessons in 1992 and to re-record 5% of grade 3 lessons in 1993.

One of the problems encountered with calculating S.E.I.'s share of administrative dues paid to AVANCE's central administration is that it is presently calculated considering the level of expenditures of S.E.I. relative to the level of expenditures of AVANCE's other units. In relation to S.E.I.'s 1990 total expenditures this percentage is 9%. It is assumed here that the share in the next three years would be 9% of S.E.I.'s total expenditures.

B. Scenario A

Scenario A, Table 3.1 below (Table 4, Annex I), where the present personnel of S.E.I. is maintained, implies an estimated average per student cost of 4.94 Lempiras or US $2.47 per year. This estimate assumes a 10% increase in student participants per year per grade. The present team has the capacity of maintaining the mathematics series and at the same time developing a new series in another subject like Spanish or Social Sciences. The figures for this scenario overstate recurrent costs for "La Familia de Los Numéros" because it include resources to develop a new series.

TABLE 3.1. SCENARIO A. RECURRENT COSTS

	1991	1992	1993	TOTAL
TOTAL COST (LEMP) '000	1,086	1,162	1,268	3,516 (a)
TOTAL COST (US$) '000				
$1 = 2 Lempiras	543	581	634	1,758
$1 = 3.4 Lempiras	319	342	373	1,034
TOTAL STUDENTS	215,250	236,750	260,500	
UNIT COST (LEMP)	5.04	4.91	4.87	
UNIT COST (US $)				
$1 = 2 Lempiras	2.52	2.45	2.43	
$1 = 3.4 Lempiras	1.48	1.44	1.43	

(a) Includes 919,452 Lempiras of donated air time

C. Scenario B

Scenario B, Table 3.2 below (Table 5, Annex I), where the technical and administrative staff of S.E.I. has been reduced to 11 people, implies an average per student recurrent cost of 3.70 Lempiras or US $1.85. This team will not be able to develop a new series like "La Familia de Los Numéros," but it will be able to revise lessons for grades 1-2 and it can follow up academic achievements and provide packages for new participants.

TABLE 3.2. SCENARIO B. RECURRENT COSTS

	1991	1992	1993	TOTAL
TOTAL COST (LEMP) '000	814	869	952	2,635 (a)
TOTAL COST (US$) '000				
$1 = 2 Lempiras	257	386	476	1,318
$1 = 3.4 Lempiras	239	256	280	775
TOTAL STUDENTS	215,250	236,750	260,500	
UNIT COST (LEMP)	3.78	3.67	3.66	
UNIT COST (US $)				
$1 = 2 Lempiras	1.89	1.84	1.83	
$1 = 3.4 Lempiras	1.02	1.08	1.08	

(a) Includes 919,452 Lempiras of donated air Time

D. Scenario C

Scenario C, Table 3.3 below (Table 6, Annex I), where the team has been reduced to four technical people plus a secretary, shows a significant decrease in annual average cost relative to Scenarios A and B. The average per student cost in Scenario C is 3.10 Lempiras or US $1.55. This minimum team can maintain the basic implementation of the radio mathematics project and provide material for new participants.

TABLE 3.3. SCENARIO C. RECURRENT COSTS

	1991	1992	1993	TOTAL
TOTAL COST (LEMP) (a) '000	670	729	812	2,211
TOTAL COST (US $) 000				
$1 = 2 Lempiras	335	364	406	1,105
$1 = 3.4 Lempiras	197	214	238	650
TOTAL STUDENTS	215,250	236,750	260,500	
UNIT COST (LEMP)	3.11	3.08	3.12	
UNIT COST (US $) 000				
$1 = 2 Lempiras	1.56	1.54	1.56	
$1 = 3.4 Lempiras	0.91	0 91	0.92	

(a) Includes 919,452 Lempiras of donated air Time

The three scenarios presented above can be summarized, for the 1991-1993 period, as follows:

TABLE 3.4 SUMMARIZED SCENARIO COMPARISON

	RECURRENT COST TOTAL FOR 1991-1993		
	Scenario A	Scenario B	Scenario C
No. Admin. Personnel	6	2	1
No. Tech. Personnel	17	9	4
Total Personnel	23	11	5
Total Cost 1991-93 ('000 Lempiras)	3,515	2,635	2,179
Less: Donated Radio Air Time	(919)	(919)	(919)
Net Amount to be Funded	2,596	1,716	1,259
Details of Net Amount to be Funded:			
AVANCE Adm. Charge	290	218	180
Salaries & Fringe	1,208	710	418
Travel	260	110	74
Other	249	128	99
Studio Operations	62	62	
Instructional Material	527	488	488
Total Lempiras	2,596	1,716	1,259
Less:(a) Revenues from Sale of Packages	224	224	224
Net Lempiras	2,372	1,492	1,035
US Equivalent (Exch. US $1 = 2 Lempiras)	1,186	746	517
(Exch. US $1 = 3.4 Lempiras)	698	439	304

(a) Assumes a 60 % recovery of the total value of packages sold

SECTION IV. COST-EFFECTIVENESS

The financial constraints in which most developing countries find themselves should be a sufficient reason for analysis of the cost-effectiveness of their educational system. For a number of years, interactive radio instruction pilot projects around the world have demonstrated large increases in internal effectiveness or increases in learning gains reflected through higher test scores, and in most cases they have also been cost-effective.

Cost-effectiveness is the ratio of the incremental gain in student achievement, stated in terms of effect size, to the incremental cost (e.g. recurrent cost) of the educational inputs (Lockheed and Hanusheck). Effect size is the ratio of average score difference between the traditional and control group to the standard deviation of the control group (see Annex III for the results of an evaluation of the program effectiveness for grades 1 and 2).

The effectiveness measure for "La Familia de los Números" is not easy to calculate precisely, because the radio lessons were introduced along with new textbooks which, in turn, were introduced with teacher training. As shown in Annex III, the impact of the total package (radio, texts, and teacher training) in grade 1 was substantial with an effect size of .80. The textbooks and teacher training resulted in a significant improvement in achievement, and the addition of the radio programs produced another substantial gain. An estimate of the additional impact of the radio is an effect size of .37.

In the second grade, the impact of the total package was .61. But in contrast to the first grade, the addition of textbooks alone had no impact at all; in fact, the test score for classes using the textbooks was a bit lower. A possible explanation of this outcome is that the textbooks arrived about half way through the year. Also teacher's guides were not provided and there was no teacher training, as had taken place for the first grade teachers. Since there was no positive impact on the classes using the textbooks alone, (assuming that they might have been used during the last part of the year), it is reasonable to conclude that the total positive impact on the learning in the experimental classes is most likely attributable to the radio lessons alone.

Therefore, the effectiveness measure to be used for the cost-effectiveness analysis will a the average of the effect sizes for the two grades (.37 and .61) or .49. This represents the incremental learning as a result of the radio programs.

The incremental cost for providing the radio lessons will be calculated using the recurrent cost as presented in the previous section for Scenario C.

The per student recurrent cost for the radio programs from 1991 - 1993 ranged from 3.08 to 3.12 Lempiras, or US $1.54 ($0.91) to $1.56 ($0.92). Thus the cost-effectiveness ratio is .32 with an exchange rate of US $1 to 2 Lempiras, or .54 with an exchange rate of 3.4 Lempiras per dollar.

SECTION V. AVERAGE ANNUAL TOTAL COST

The total annual cost of the "La Familia de los Números" series is the sum of the development costs (including both the development of the materials and national implementation) amortized over ten years and adjusted for the opportunity cost at 17%, and the average recurrent cost.

	Lempiras	Dollars
Development Cost[1] 17% opportunity cost Annualized over 10 years	841,873	420,936
Recurrent cost (Scenario C)	726,254	363,127
Total Annual Cost	1,568,127	784,063
Cost per student	6.50	
In US Dollars		
Exchange US $1 = 2 Lempiras		3.25
Exchange US $1 = 3.4 Lempiras		1.91

[1] Cost studies of similar programs in other countries have used an opportunity cost or discount rate of 7.5% and have amortized the program over fifteen years. If these assumptions were applied to the data in Honduras, the results would be as follows:

Total per student cost would be $3.10 at an exchange of 2 Lempiras per dollar, and $1.83 at an exchange of 3.4 Lempiras per dollar.

ANNEX I

SUMMARY OF TABLES

ANNEX II

PROJECT DEVELOPMENT PHASES

The first year (1987), the team (smaller than the present) undertook what is considered basic research. It consisted of tests given to randomly selected children of 5-7 years of age which were the ones to initiate first grade of primary school the following year. These tests were designed to evaluate children's ability to count, hold a pen, recognize shapes and colors, differentiate between letters which may seem similar (e.g., b and p) and mentally solve math problems.

Written tests were also given to estimate how much arithmetic they knew before entering first grade. This is because the majority of children in Honduras attend public schools (94%) and do not receive pre-school education.

The results from these tests were used to decide what type of curriculum should be designed for transmission. Test results indicated that the area of greatest weakness was the one of mental calculation. Because of that, the radio lessons, although they follow the Ministry of Education's official curriculum, were designed to improve mental calculation skills.

The phase of basic research took approximately six months. In cooperation with Friend's Dialogues, decisions were made on design and content of lessons and on the number of lessons to be transmitted. Once the content was specified, scriptwriter began to develop scripts for the actors to follow and production was initiated. The curriculum for first grade was introduced in 1988, second grade in 1989 and third grade in 1990.

When transmission started in 1988, S.E.I.'s evaluation team worked with a group of 48 schools to visit periodically to observe the execution of the lessons. These observations were essential for designing a high quality curriculum. During their visits, they collected information related to reception by the children and teachers, and evaluated recording qualities such as clarity of voices and the time allowed for children to answer the questions posted through the radio. This information was used to inform the production team and improve the quality of the lessons by making the necessary changes to increase learning gains.

Evaluators also gave tests on selected topics four weeks and two weeks before their transmission and two and four weeks after transmission. These tests gave information on the children's learning gains by topic, which in turn affected the overall study plans. If after four weeks it was found that 80% of the children knew the topic very well, additional lessons on the topic were reduced and if the opposite occurred additional lessons were designed.

The number of schools in the evaluation process has remained relatively stable. There were 48 in 1988 and 1989 and there are 43 in 1990.

Training sessions of one day on average are given to the teachers participating in the program. Moreover, training is given to students in their last year of schooling before graduating as educators. In 1990, 12 teacher training schools and a total of 80 potential educators received training in interactive radio instruction.

ANNEX III

IMPACT OF RADIO EDUCATION

The evaluation team of S.E.I. has collected annual information on learning gains for first, second and third graders. This information was used by Friend Dialogues to prepare in-depth statistical analysis of learning gains. Statistical analysis of first graders was made at the end of the 1988 school year and of second graders at the end of 1989. Third grade analysis is not available since 1990 was the first year of transmission.

Friend's (1988) preliminary results found significant improvements in children exposed to the radio interactive program stressing mental calculation. She performed a comparative analysis between three different groups:

Group A: children with traditional instruction
Group B: children with new textbooks
Group C: children with new textbooks and radio

The traditional group, Group A, was tested at the end of 1987 before the new textbooks were available. Groups B and C were tested at the end of 1988. Groups A and C are composed of children in the same region (Francisco Morazan) and in the same schools tested a year apart. These groups are considered highly comparable since they come from similar socio-economic conditions and had similar teachers.

Group B is in a different area of the country (El Paraiso) and could have better or less qualified teachers and/or better or worse economic conditions. Because there was a time constraint, a pre-test for this group was not given. In order to compensate for lack of pre-test, comparisons between school systems and the children who attend them were made. It was found that the average score in Francisco Morazan was 51.4% and in El Paraiso was 52.5%. With a t-statistic of 0.85 and p= 0.395, differences in average scoring are insignificant and thus the groups are comparable.

Effect size is the ratio of average score difference between the traditional and control group to the standard deviation of the control group. In general, effect sizes of 0.8 are rarely achieved, thus there is confidence in asserting that the radio interactive mental calculation program with textbooks has been of great benefit (see Table 9).

The size of the differences is significant for all three groups. The effect size of improvements as a result of new textbooks over traditional instruction is 0.43. The effect size

of radio combined with new textbooks is nearly twice as large: 0.80. It is evident that new textbooks and radio lessons have been effective, and it is clear that a combination of the two yields significantly high learning gains. It is not possible to say with certainty that radio alone could have produced the same learning gains because there was not a group with the radio program as the only learning tool. Also, because the radio program was designed to work on a skill in which the children were weak, mental calculation, and does not cover the entire official curriculum it could not be credited with gains in other areas.

TABLE 9. STATISTICAL ANALYSIS FOR FIRST GRADE, 1988.

	TRADITIONAL	TEXTBOOKS	TEXTBOOKS & RADIOS
	GROUP A N = 553	GROUP B N = 613	GROUP C N = 473
Mean Score	34.3%	43.7%	51.9%
Standard Deviation	21.9	22.1	25.2

Effect size of difference:

Radio & textbooks	vs.	Textbooks	0.37
Radio & textbooks	vs.	Traditional	0.80
Textbooks	vs.	Traditional	0.43

Source: Jamesine Friend, Feb. 1989

Preliminary statistical analysis of second graders (see Table 10) shows significant differences between Group C (children with new textbooks and radio) and Group A (children with traditional instruction). However, the schools using the textbooks only in the second grade did no better than schools in the traditional or control group. In fact, they scored somewhat lower (48.6% with textbooks vs. 52.5% in traditional classes resulting in an effect size of -0.19). This may be accounted for by the fact that the textbooks arrived late, about half way through the year. In addition, there were accompanying teacher's guide and no teacher training as was provided for first grade teachers.

Whatever the reason, assuming that the circumstances with the textbooks were the same in both the "textbook" classes and the "radio plus textbook" classes, it appears that the positive impact in the latter group of classes can be accounted for by the radio lessons.

TABLE 10. STATISTICAL ANALYSIS FOR SECOND GRADE, 1989.

	TRADITIONAL	TEXTBOOKS	TEXTBOOKS & RADIOS
	GROUP A N = 393	GROUP B N = 500	GROUP C N = 411
Mean Score	52.0%	48.6	63.5%
Standard Deviation	18.7	19.3	16.9%

Effect size of difference:

Radio & textbooks	vs.	Textbooks	0.77
Radio & textbooks	vs.	Traditional	0.61
Textbooks	vs.	Traditional	-0.19

Source: Jamesine Friend, May 1990.

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TABLE 1. DEVELOPMENT COSTS FOR "LA FAMILIA DE LOS NUMEROS PROJECT". 1987-1990
DEVELOPMENT AND IMPLEMENTATION COMPONENTS
TEGUCIGALPA, HONDURAS
LEMPIRAS

A. ADMIN. PERSONNEL	1987 AMOUNT	1988 AMOUNT	1989 AMOUNT	1990 AMOUNT	TOTAL DEVELOPMENT
AVANCE Adm CHARGE	15,176.00	95,331.00	100,578.50	69,403.00	280,488.50
SECRETARY	4,320.00	7,653.18	10,979.98	12,644.18	35,597.34
ACCOUNTANT					
MARKETING COORD.					
ASSIST. MARKETING					
DRIVER	2,158.35	350.00	2,100.00	1,400.00	6,008.35
CLEANER		1,650.00	970.82	1,153.00	3,773.82
GUARD		1,050.00	2,815.00	2,600.00	6,465.00
TEMP. PERSONNEL	2,514.00	10,921.16	5,761.28	4,792.50	23,988.94
SUBTOTAL A	24,168.35	116,955.34	123,205.56	91,992.68	356,321.94
B. TECH. PERSONNEL					
DIRECTOR	20,800.00	15,600.00	17,600.00	19,592.00	73,592.00
PRODUCTION COORD.				9,695.00	9,695.00
SOUND TECHN	5,280.00	9,600.00	10,050.00	6,805.03	31,655.03
ACTORS		7,200.00	12,600.00	3,200.00	23,000.00
SCRIPTWRITERS	51,700.00	66,400.00	66,960.00	82,436.00	269,556.00
EVALUATORS	8,346.66	6,720.00	6,600.00	7,766.67	27,433.33
EDITOR		19,100.00	30,200.00		49,300.00
EVALUATION COORD	7,200.00	10,800.00	11,800.00	13,025.00	42,825.00
COMPUTER ENG.					
FRINGE BENEFITS	26,819.23	15,710.15	20,468.91	20,468.91	83,467.19
SUB-TOTAL B	118,125.89	151,130.15	178,278.91	162,988.61	610,523.55
C. OPERATING/EQUIP					
RENT	24,730.00	15,000.00	24,000.00	21,500.00	85,230.00
UTILITIES	12,969.62	3,972.54	3,141.79	1,862.88	21,946.83
VEHICLES		59,804.93	1,905.39	5,636.39	67,346.71
GASOLINE		3,377.18	4,238.50	7,936.10	15,551.78
TRAVEL/PER DIEM	4,103.65	15,567.67	22,742.43	14,306.28	56,720.03
BLD/FURN REPAIR	7,317.17	3,908.61	5,921.61	3,761.03	20,908.42
VEHICLE REPAIR	9,833.26	1,629.49	5,302.19	10,614.54	27,379.47
EQUIP.REPAIR		337.29	192.02	2,369.68	2,898.98
STUDIO	3,664.25	3,053.50	16,930.79		23,648.54
STUDIO EQUIP.	7,711.38	18,994.54	126,660.90		153,366.82
COMPUTER HARDW			46,485.54		46,485.54
COMPUTER SOFTW			19,295.92		19,295.92
FURNITURE	16,490.13	1,399.63	21,657.00		39,546.76
PRINTER			10,980.00		10,980.00
PHOTOCOPIER	4,466.00		863.00	298.72	5,627.72
TYPEWRITER	3,238.20				3,238.20
TAPE RECORDERS	4,540.60	580.00		2,282.70	7,403.30
RECORDING COSTS		1,968.23	11,685.92	11,661.00	25,315.15
MISCELLANEOUS	27,436.82	5,891.80	3,226.56	17,489.78	54,044.95
SUPERVISORS COMM.					
AIR TIME COST					
SHIPPING/DISTRIB		4,276.65	10,034.79	6,260.83	20,572.27
PACKAGING					
TRAINING					
ADVERTISING					
OFF.PAPER/SUPPLIES	20,183.94	9,219.55	13,796.86	11,690.72	54,891.09
INSTRUCT. MATERIAL					
SUB-TOTAL C	146,685.02	148,981.60	349,061.20	117,670.64	762,398.46
D. TEC. ASSISTANCE	450,928.00	683,629.00	830,244.00	270,858.00	2,235,659.00
SUB-TOTAL D	450,928.00	683,629.00	830,244.00	270,858.00	2,235,659.00
GRAND TOTAL COST	739,907.26	1,100,696.09	1,480,789.66	643,509.92	3,964,902.95
US $$ EQUIVALENT	369,953.63	550,348.05	740,394.84	321,754.96	1,982,451.48
TOTAL WITH OPPORTUITY COST	449,366.62	666,483.86	899,325.46	390,821.76	2,407,997.76

SOURCE: AVANCE/S.E.I . HONDURAS SEPT. 1990
NOTE: PER YEAR EXPENDITURES/DISBURSEMENT
INSTRUCTIONAL MATERIAL INCLUDES EVERYTHING IN PACKAGES
1990 SALARIES INCLUDE PAYMENTS UNTIL DEC. 1990
Q= QUANTITY

TABLE 2. IMPLEMENTATION COSTS FOR "LA FAMILIA DE LOS NUMEROS PROJECT"
TEGUCIGALPA, HONDURAS
LEMPIRAS

A. ADMIN. PERSONNE	1987 AMOUNT	1988 AMOUNT	1989 AMOUNT	1990 AMOUNT	TOTAL IMPLEMENTATION
AVANCE Adm. CHARGE		95,331.00	100,578.50	69,403.00	265,312.50
SECRETARY		7,653.18	10,979.98	12,644.18	31,277.34
ACCOUNTANT					
MARKETING COORD.		5,200.00	12,833.33	14,533.60	32,566.93
ASSIST. MARKETING				25,500.60	25,500.60
DRIVER		350.00	2,100.00	1,400.00	3,850.00
CLEANER		1,650.00	970.82	1,153.00	3,773.82
GUARD		1,050.00	2,815.00	2,600.00	6,465.00
TEMP. PERSONNEL		10,921.16	5,761.28	4,792.50	21,474.94
SUBTOTAL A		122,155.34	136,038.91	131,026.88	390,221.12
B. TECH. PERSONNEL					
DIRECTOR		15,600.00	17,600.00	19,592.00	52,792.00
PRODUCTION COORD.					
SOUND TECHN.					
ACTORS					
SCRIPTWRITERS					
EVALUATORS		6,720.00	6,600.00	7,766.67	21,086.67
EDITOR					
EVALUATION COORD		10,800.00	11,800.00	13,025.00	35,625.00
COMPUTER ENG.		7,497.00		10,299.00	17,796.00
FRINGE BENEFITS		15,710.15	20,468.91	20,468.91	56,647.96
SUB-TOTAL B		56,327.15	56,468.91	71,151.58	183,947.63
C. OPERATING/EQUIP					
RENT		15,000.00	24,000.00	21,500.00	60,500.00
UTILITIES		3,972.54	3,141.79	1,862.88	8,977.21
VEHICLES		5,804.94	1,905.39	5,636.39	13,346.72
GASOLINE		3,377.18	4,238.50	7,936.10	15,551.78
TRAVEL/PER DIEM		15,567.67	22,742.43	14,306.28	52,616.38
BLD/FURN REPAIR		3,908.61	5,921.61	3,761.03	13,591.25
VEHICLE REPAIR		1,629.49	5,302.19	10,614.54	17,546.21
EQUIP.REPAIR		337.29	192.02	2,369.66	2,898.98
STUDIO					
STUDIO EQUIP.					
COMPUTER HARDW					
COMPUTER SOFTW					
FURNITURE					
PRINTER					
PHOTOCOPIER					
TYPEWRITER					
TAPE RECORDERS					
RECORDING COSTS					
MISCELLANEOUS		5,891.80	3,226.56	17,489.78	26,608.13
SUPERVISORS COMM.	18.46	8,031.00	19,718.50	8,146.00	35,913.96
AIR TIME COST		260,000.00	169,200.00	268,000.00	697,200.00
SHIPPING/DISTRIB					
PACKAGING		144.00	551.27	635.08	1,330.35
TRAINING	1,161.59		1,160.00		2,321.59
ADVERTISING	4,572.62	166,162.47	300,142.99	34,769.30	505,647.38
OFF.PAPER/SUPPLIES		9,219.55	13,796.88	11,690.72	34,707.15
INSTRUCT. MATERIAL		85,101.64	305,500.00	401,929.55	792,531.19
SUB-TOTAL C	5,752.67	584,148.17	880,740.10	810,647.32	2,281,288.26
D. TEC. ASSISTANCE		36,081.00	52,371.60	22,139.80	110,592.40
SUB-TOTAL D		36,081.00	52,371.60	22,139.80	110,592.40
GRAND TOTAL COST	5,752.67	798,711.66	1,125,619.51	1,035,965.57	2,966,049.41
US $$ EQUIVALENT	2,676.34	395,355.83	562,809.76	517,982.79	1,483,024.71
TOTAL WITH OPPORTUITY COST	3,493.76	485,080.19	683,620.56	629,171.21	1,801,365.74

SOURCE: AVANCE/S.E
NOTE: PER YEAR EXP
INSTRUCTIONAL MATE
1990 SALARIES INCL
Q= QUANTITY
TECH. ASSIST. COMM

TABLE 3. TOTAL INVESTMENTS FOR "LA FAMILIA DE LOS NUMEROS PROJECT". 1987-1990
INCLUDES DEVELOPMENT AND IMPLEMENTATION COSTS
TEGUCIGALPA, HONDURAS
LEMPIRAS

ADMIN. PERSONNEL	1987 Q	1987 TOTAL COST	1988 Q	1988 TOTAL COST	1989 Q	1989 TOTAL COST	1990 Q	1990 TOTAL COST	TOTAL 1987-1990
AVANCE SHARE		15,176.00		190,662.00		201,157.00		138,806.00	545,801.00
SECRETARY	2	4,320.00	2	15,306.36	3	21,959.96	3	25,288.35	66,874.67
ACCOUNTANT									
MARKETING COORD.			1	5,200.00	1	12,833.33	1	14,533.60	32,566.93
ASSIST. MARK.							2	25,500.60	25,500.60
DRIVER	1	2,158.35	1	700.00	1	4,200.00	1	2,800.00	9,858.35
CLEANER			1	3,300.00	1	1,941.64	1	2,306.00	7,547.64
GUARD			1	2,100.00	2	5,630.00	2	5,200.00	12,930.00
TEMP. PERSONNEL	1	2,514.00		21,842.32		11,522.55		9,585.00	45,463.87
SUBTOTAL A		24,168.35		239,110.68		259,244.48		224,019.55	746,543.06
TECH. PERSONNEL									
DIRECTOR	1	20,800.00	1	31,200.00	1	35,200.00	1	39,184.00	126,384.00
PRODUCTION COORD.							1	9,695.00	9,695.00
SOUND TECHN.	1	5,200.00	1	9,600.00	1	10,050.00	1	6,805.03	31,655.03
ACTORS			1	7,200.00	2	12,600.00	3	3,200.00	23,000.00
SCRIPTWRITERS	5	51,760.00	4	66,400.00	5	68,960.00	5	82,436.00	269,556.00
EVALUATORS	2	6,346.66	2	13,440.00	1	13,200.00	3	15,533.34	48,520.00
EDITOR			1	19,100.00	2	30,200.00			49,300.00
EVALUATION COORD	1	7,200.00	1	21,600.00	1	23,600.00	1	26,050.00	78,450.00
COMPUTER ENG.				7,497.00	1		1	10,299.00	17,796.00
FRINGE BENEFITS		26,819.23		31,420.30		40,937.81		40,937.81	140,115.15
SUB-TOTAL B		118,125.89		207,457.30		234,747.81		234,140.18	794,471.18
OPERATING/EQUIP.									
RENT		24,730.00		30,000.00		48,000.00		43,000.00	145,730.00
UTILITIES		12,969.62		7,945.08		6,283.58		3,725.76	30,924.04
VEHICLES				65,609.87		3,810.78		11,272.78	80,693.43
GASOLINE				6,754.35		8,477.00		15,872.20	31,103.55
TRAVEL/PER DIEM		4,103.65		31,135.34		45,484.85		28,612.56	109,336.40
BLD/FURN REPAIR		7,317.17		7,817.22		11,843.21		7,522.06	34,499.66
VEHICLE REPAIR		9,833.26		3,258.98		10,604.37		21,229.07	44,925.68
EQUIP.REPAIR				674.58		384.03		4,739.35	5,797.96
STUDIO		3,664.25		3,053.50		16,930.79			23,648.54
STUDIO EQUIP.		7,711.38		18,994.54		126,660.90			153,366.82
COMPUTER HARDW						46,485.54			46,485.54
COMPUTER SOFTW						19,295.92			19,295.92
FURNITURE		16,490.13		1,399.63		21,657.00			39,546.76
PRINTER						10,980.00			10,980.00
PHOTOCOPIER		4,466.00				863.00		298.72	5,627.72
TYPEWRITER		3,238.20							3,238.20
TAPE RECORDERS		4,540.60		580.00				2,282.70	7,403.30
RECORDING COSTS				1,968.23		11,685.92		11,661.00	25,315.15
MISCELLANEOUS		27,436.82		11,783.59		6,453.11		34,979.56	80,653.08
SUPERVISORS COMM.		18.46		8,031.00		19,718.50		8,146.00	35,913.96
AIR TIME COST				260,000.00		169,200.00		268,000.00	697,200.00
SHIPPING/DISTRIB				4,276.65		10,034.79		6,260.83	20,572.27
PACKAGING				144.00		551.27		635.08	1,330.35
TRAINING		1,161.59				1,160.00			2,321.59
ADVERTISING		4,572.62		166,162.47		300,142.99		34,769.30	505,647.38
OFF.PAPER/SUPPLIES		20,183.94		18,439.10		27,593.75		23,381.44	89,598.23
INSTRUCT. MATERIAL				85,101.64		305,500.00		401,929.55	792,531.19
SUB-TOTAL C		152,437.69		733,129.77		1,229,801.30		928,317.96	3,043,686.72
TECHNICAL ASSIST.		450,928.00		719,710.00		882,616.00		292,998.00	2,346,252.00
SUB-TOTAL D		450,928.00		719,710.00		882,616.00		292,998.00	2,346,252.00
GRAND TOTAL COST		745,659.93		1,899,407.75		2,606,409.59		1,679,475.69	6,930,952.96
IN US DOLLARS		372,829.97		949,703.88		1,303,204.80		839,737.85	3,465,476.48
TOTAL IN US $ WITH OPPORTUNITY COST 17%		452,860.38		1,153,564.08		1,582,946.30		1,019,993.11	4,209,363.87

SOURCE: AVANCE/S.E.I , HONDURAS SEPT. 1990
NOTE: PER YEAR EXPENDITURES/DISBURSEMENT
INSTRUCTIONAL MATERIAL INCLUDES EVERYTHING IN PACKAGES
1990 SALARIES INCLUDE PAYMENTS UNTIL DEC. 1990
Q= QUANTITY

TABLE 4 SCENARIO A RECURRENT COSTS FOR "LA FAMILIA DE LOS NUMEROS".
TEGUCIGALPA, HONDURAS
LEMPIRAS

ADMIN. PERSONNEL	Q	INFLAT. FACT.	1991 TOTAL COST	1992 TOTAL COST	1993 TOTAL COST	1991-1993 COMBINED
AVANCE ADM. CHARGE		1.06	89,669.31	95,930.78	104,704.85	290,304.94
SECRETARY	3	1.06	26,805.65	26,413.99	30,118.83	85,336.47
ACCOUNTANT						
MARKETING COORD.	1	1.09	15,693.36	17,105.79	18,645.31	51,444.48
ASSIST. MARK.	2	1.09	26,821.19	29,235.10	31,866.26	87,922.56
DRIVER		1.06				
CLEANER		1.06				
GUARD		1.06				
TEMP. PERSONNEL		1.06	10,100.10	10,709.71	11,415.69	32,345.69
SUBTOTAL A1			79,480.33	85,524.59	92,046.29	257,051.20
SUBTOTAL A2			169,149.64	181,455.36	196,751.14	547,356.15
TECH PERSONNEL						
DIRECTOR	1	1.09	40,302.75	43,930.00	47,883.70	132,116.44
PRODUCTION COORD.	1	1.09	10,436.75	11,376.00	12,399.90	34,212.71
SOUND TECHN.	1	1.09	7,297.58	7,954.37	8,670.20	23,922.21
ACTORS	4	1.09	10,355.00	11,286.95	12,302.78	33,944.73
SCRIPTWRITERS	5	1.09	89,855.24	97,942.21	106,757.01	294,554.46
EVALUATORS	2	1.09	21,814.54	23,777.85	25,917.86	71,510.25
PROGRAM COORD.	1	1.09	27,228.20	29,678.74	32,349.82	89,256.76
EVALUATION COORD	1	1.09	27,239.10	29,690.62	32,362.77	89,292.49
COMPUTER ENG.	1	1.09	11,090.75	12,086.92	13,176.92	36,356.59
FRINGE BENEFITS		1.09	44,622.21	48,638.21	53,015.65	146,276.08
SUB-TOTAL B			290,242.13	316,363.92	344,836.67	951,442.71
OPERATING/EQUIP.						
RENT		1.06	38,160.00	40,449.60	42,876.58	121,486.18
UTILITIES		1.06	5,844.03	6,194.68	6,566.36	18,605.07
VEHICLES		1.06	11,949.15	12,666.10	13,426.06	38,041.30
GASOLINE		1.06	16,824.53	17,834.00	18,904.04	53,562.58
TRAVEL/PER DIEM		1.06	30,329.31	32,149.07	34,078.02	96,556.40
BLD/FURN REPAIR		1.06	4,240.00	4,494.40	4,764.06	13,498.46
VEHICLE REPAIR		1.06	22,502.81	23,852.98	25,284.16	71,639.96
EQUIP.REPAIR		1.06	4,240.00	4,494.40	4,764.06	13,498.46
STUDIO			2,127.27	1,890.91	1,654.55	5,672.73
RECORDING COSTS		1.06	29,535.84	17,337.60	9,109.60	55,983.04
MISCELLANEOUS		1.06	2,904.32	3,078.57	3,417.22	9,400.11
AIR TIME COST		1.06	284,080.00	301,124.80	334,248.53	919,453.33
PACKAGING/DISTR		1.06	7,309.66	7,748.24	8,600.55	23,658.46
TRAINING		1.06				
OFF.PAPER/SUPPLIES		1.06	15,264.00	16,179.84	17,959.62	49,403.46
INSTRUCT. MATERIAL						
RADIOS		1.06	39,814.83	46,275.35	53,629.82	139,720.00
T/GUIDES		1.06	39,063.56	45,402.20	52,617.91	137,083.69
WORKBOOK		1.06	57,041.30	66,297.06	76,833.56	200,171.92
BATTERIES		1.06	12,203.57	12,894.34	13,585.10	38,683.01
POSTER SETS		1.06	564.53	656.13	760.41	1,981.07
CARRY BAG			2,036.37	2,366.80	2,742.96	7,146.13
SUPERVISORS COMM.			568.13	621.94	681.13	1,871.20
SUB-TOTAL C			626,603.24	664,009.02	726,504.30	2,017,116.56
GRAND TOTAL COST			1,085,995.01	1,161,828.30	1,268,092.11	3,515,915.42
COST/STUDENT US$						
$1 = 2 LEMPIRAS			2.52	2.45	2.43	
$1 = 3.4 LEMPIRAS			1.48	1.44	1.43	

SOURCE: AVANCE/S.E.I. HO1990
NOTE
6 % ANNUAL INFLATION RAT
3 % PRODUCTIVITY ADJUSTM

TABLE 5 SCENARIO B. RECURRENT COSTS FOR "LA FAMILIA DE LOS NUMEROS".

ADMIN. PERSONNEL	Q	ADJUST. FACT.	1991 TOTAL COST	1992 TOTAL COST	1993 TOTAL COST	1991-1993 COMBINED
			LEMPIRAS			
AVANCE ADM. CHARGE		1.06	67,220.94	71,772.34	76,643.70	217,636.99
SECRETARY	1	1.06	10,317.35	10,936.39	11,592.58	32,846.32
ACCOUNTANT						
MARKETING COORD	1	1.09	15,603.38	17,105.79	18,645.31	51,444.48
ASSIST. MARK.						
DRIVER						
CLEANER						
GUARD						
TEMP. PERSONNEL		1.06	10,160.10	10,769.71	11,415.89	32,345.69
SUBTOTAL A1		1.06	30,178.84	38,811.89	41,653.77	110,636.50
SUBTOTAL A2			103,391.76	110,584.23	120,297.48	334,273.48
TECH. PERSONNEL						
DIRECTOR	1	1.09	40,302.75	43,930.00	47,883.70	132,116.44
PRODUCTION COORD	1	1.06	10,436.75	11,376.06	12,399.90	34,212.71
SOUND TECHN	1	1.06	7,297.58	7,954.37	8,670.26	23,922.21
ACTORS						
SCRIPTWRITERS	3	1.09	62,334.92	67,945.06	74,060.12	204,340.10
EVALUATORS	1	1.06	6,335.44	6,905.99	7,531.89	20,781.32
PROGRAM COORD.	1	1.09	27,228.20	29,678.74	32,349.82	89,256.76
EVALUATION COORD	1	1.09	27,236.10	29,690.62	32,362.77	89,292.49
COMPUTER ENG.						
FRINGE BENEFITS		1.06	22,790.53	24,164.32	25,614.18	72,575.03
SUB-TOTAL B		1.06	181,178.74	197,484.83	215,258.40	593,922.04
OPERATING/EQUIP.						
RENT		1.06	19,988.57	21,187.89	22,459.16	63,635.62
UTILITIES		1.06	2,922.02	3,097.34	3,283.18	9,302.53
VEHICLES						
GASOLINE		1.06	8,412.27	8,917.00	9,452.02	26,781.29
TRAVEL/PER DIEM		1.06	15,164.66	16,074.54	17,039.01	48,278.20
BLD/FURN REPAIR		1.06	2,120.00	2,247.20	2,382.03	6,749.23
VEHICLE REPAIR		1.06	11,251.41	11,926.49	12,642.08	35,819.98
EQUIP.REPAIR		1.06	2,120.00	2,247.20	2,382.03	6,749.23
STUDIO			2,127.27	1,890.91	1,654.55	5,672.73
RECORDING COSTS		1.06	29,535.84	17,337.60	9,109.60	55,983.04
MISCELLANEOUS		1.06	1,452.16	1,539.29	1,708.61	4,700.05
AIR TIME COST		1.06	284,080.00	301,124.80	334,248.53	919,453.33
PACKAGING/DISTR		1.06	3,654.83	3,874.12	4,300.28	11,829.23
OFF.PAPER/SUPPLIES		1.06	7,632.00	8,089.92	8,979.81	24,701.73
INSTRUCT. MATERIAL						
RADIOS			39,814.83	46,275.35	53,629.82	139,720.00
T/GUIDES			39,063.58	45,402.20	52,617.91	137,083.69
WORKBOOK			57,041.30	66,297.06	76,833.56	200,171.92
BATTERIES						
POSTER SETS			544.53	656.13	760.41	1,981.07
CARRY BAG			2,036.37	2,366.80	2,742.96	7,146.13
SUPERVISORS COMM.			568.13	621.94	681.13	1,871.20
SUB-TOTAL C			529,549.76	561,173.77	616,906.67	1,707,630.21
GRAND TOTAL COST			814,120.28	869,242.83	952,462.61	2,635,825.72
COST/STUDENT US$						
US$1 = 2 LEMPIRAS			1.89	1.84	1.83	
US$1 =3.4 LEMPIRAS			1.11	1.08	1.08	

SOURCE: AVANCE/S.E.I. H 1990

NOTE: ADJUSTMENT FACTORATION & PRODUCTIVITY

6 % ANNUAL INFLATION RA

3 % PRODUCTIVITY ADJUST

TABLE E. SCENARIO C. RECURRENT COSTS FOR "LA FAMILIA DE LOS NUMEROS".
LEMPIRAS

ADMIN PERSONNEL	Q	ADJUST. FACT	1991 TOTAL COST	1992 TOTAL COST	1993 TOTAL COST	1991-1993 COMBINED
AVANCE ADM. CHARGE		1.06	54,486.62	59,341.24	66,007.97	179,897.83
SECRETARY	1	1.06	10,317.35	10,936.39	11,592.58	32,846.32
ACCOUNTANT						
MARKETING COORD						
ASSIST MARK.						
DRIVER						
CLEANER						
GUARD						
TEMP. PERSONNEL						
SUBTOTAL A1		1.06	10,317.35	10,936.39	11,592.58	32,846.32
SUBTOTAL A2			64,805.97	70,277.63	77,660.55	212,744.15
TECH. PERSONNEL						
DIRECTOR	1	1.06	46,302.75	49,930.00	47,863.70	132,116.44
PRODUCTION COORD						
SOUND TECHN.						
ACTORS						
SCRIPTWRITERS	1	1.09	18,792.60	20,484.02	22,327.59	61,604.32
EVALUATORS						
PROGRAM COORD.	1	1.09	27,228.20	29,678.74	32,349.82	89,256.76
EVALUATION COORD	1	1.09	27,239.10	29,690.62	32,362.77	89,292.49
COMPUTER ENG.						
FRINGE BENEFITS		1.09	14,400.42	15,270.80	16,187.05	45,864.27
SUB-TOTAL B			127,969.10	139,054.19	151,110.94	418,134.29
OPERATING/EQUIP.						
RENT		1.06	7,268.57	7,704.69	8,166.97	23,140.22
UTILITIES		1.06	1,948.01	2,064.89	2,188.79	6,201.69
VEHICLES						
GASOLINE		1.06	5,608.18	5,944.67	6,301.35	17,854.19
TRAVEL/PER DIEM		1.06	10,109.77	10,716.36	11,355.34	32,185.47
BLD/FURN REPAIR		1.06	1,413.33	1,498.13	1,588.02	4,499.49
VEHICLE REPAIR		1.06	7,500.94	7,950.99	8,428.05	23,879.99
EQUIP.REPAIR		1.06	1,413.33	1,498.13	1,588.02	4,499.49
STUDIO						
RECORDING COSTS						
MISCELLANEOUS		1.06	1,187.16	1,258.39	1,396.81	3,842.35
AIR TIME COST		1.06	284,080.00	301,124.80	334,248.53	919,453.33
PACKAGING/DISTR		1.05	2,436.55	2,582.75	2,866.85	7,886.15
OFF.PAPER/SUPPLIES		1.06	5,088.00	5,393.28	5,986.54	16,467.82
INSTRUCT. MATERIAL						
RADIOS			39,814.83	40,275.35	53,629.82	139,720.00
T/GUIDES			39 063.58	45,402.20	52,617.91	137,083.69
WORKBOOK			57,041.30	66,297.06	76,833.56	200,171.92
BATTERIES						
POSTER SETS			564.53	656.13	760.41	1,981.07
CARRY BAG			2,036.37	2,366.80	2,742.95	7,146.13
SUPERVISORS COMM.			568.13	621.94	681.13	1,871.20
		139,089				
SUB-TOTAL C			457,142.59	509,356.56	571,385.06	1,547,884.20
GRAND TOTAL COST			699,917.72	718,686.38	800,156.54	2,178,762.64
COST/STUDENT US$						
US$1 = 2 Lempiras			1.53	1.52	1.54	
US$1 =3.4 Lempiras			0.90	0.89	0.90	

SOURCE: AVANCE/S.E.I. H 1990
NOTE: ADJUSTMENT FACTORATION & PRODUCTIVITY
6 % ANNUAL INFLATION RA
3 % PRODUCTIVITY ADJUST

TABLE 7 SCENARIO B. TOTAL COSTS FOR 'LA FAMILIA DE LOS NUMEROS'
INCLUDES AMMORTIZATION AND OPPORTUNITY COSTS
LEMPIRAS

ADMIN. PERSONNEL	1990 Q	1990 TOTAL COST	ADJUST. FACT.	1991 TOTAL COST	1992 TOTAL COST	1993 TOTAL COST
AVANCE SHARE			1.06	67,220.94	71,772.34	78,643.70
SECRETARY	1	9,733.35	1.06	10,317.35	10,936.39	11,592.58
ACCOUNTANT						
MARKETING COORD.	1	14,397.60	1.09	15,693.38	17,105.79	18,645.31
ASSIST. MGR.						
DRIVER						
CLEANER						
GUARD						
TEMP. PERSONNEL		[illegible]	1.06	10,160.10	[illegible]	11,415.85
SUBTOTAL A1		33,715.95	1.06	36,170.84	38,811.89	41,653.77
SUBTOTAL A2				103,391.78	110,584.23	120,297.46
TECH. PERSONNEL						
DIRECTOR	1	36,975.00	1.09	40,302.75	43,930.00	47,883.70
PRODUCTION COORD.	1	9,575.00	1.09	10,436.75	11,376.06	12,399.90
SOUND TECHN	1	6,695.00	1.09	7,297.55	7,954.37	8,670.26
ACTORS						
SCRIPTWRITERS	3	57,188.00	1.09	62,334.92	67,945.06	74,060.12
EVALUATORS	1	5,816.00	1.09	6,339.44	6,909.99	7,531.89
PROGRAM COORD.	1	24,980.00	1.09	27,228.20	29,678.74	32,349.82
EVALUATION COORD	1	24,990.00	1.09	27,239.10	29,690.62	32,362.77
COMPUTER ENG.						
FRINGE BENEFITS		22,062.24	1.06	23,385.97	24,789.13	26,276.48
SUB-TOTAL B		166,219.03	1.06	181,178.74	197,484.83	215,258.46
OPERATING/EQUIP.						
RENT		18,857.14	1.06	19,988.57	21,187.89	22,459.16
UTILITIES		2,756.62	1.06	2,922.02	3,097.34	3,283.18
VEHICLES						
GASOLINE		7,936.10	1.06	8,412.27	8,917.00	9,452.02
TRAVEL/PER DIEM		14,306.28	1.06	15,164.66	16,074.54	17,039.01
BLD/FURN REPAIR		2,000.00	1.06	2,120.00	2,247.20	2,382.03
VEHICLE REPAIR		10,614.54	1.06	11,251.41	11,926.49	12,642.08
EQUIP.REPAIR		2,000.00	1.06	2,120.00	2,247.20	2,382.03
STUDIO				2,127.27	1,890.91	1,654.55
RECORDING COSTS		27,864.00	1.06	29,535.84	17,337.60	9,109.60
MISCELLANEOUS		1,369.96	1.06	1,452.16	1,539.29	1,708.61
AIR TIME COST		268,000.00	1.06	284,080.00	301,124.80	334,248.53
PACKAGING/DISTR		3,447.96	1.06	3,654.83	3,874.12	4,300.28
OFF.PAPER/SUPPLIES		7,200.00	1.06	7,632.00	8,089.92	8,975.81
INSTRUCT. MATERIAL						
RADIOS				39,814.83	46,275.35	53,629.82
T/GUIDES				39,063.58	45,402.20	52,617.91
WORKBOOK				57,041.30	66,297.06	76,833.56
BATTERIES						
POSTER SETS				564.53	656.13	760.41
CARRY BAG				2,036.37	2,366.80	2,742.96
SUPERVISORS COMM.				568.13	621.94	661.13
SUB-TOTAL C				529,549.76	561,173.77	616,906.67
TOTAL COST				814,120.28	869,242.83	952,462.61
AMORTIZATION	10 Years			693,095.30	693,095.30	693,095.30
OPPORTUNITY COST	17%			136,480.45	147,771.28	161,918.64
GRAND TOTAL COST				1,645,616.02	1,710,109.41	1,807,476.55

SOURCE: AVANCE/S.E.I. HONDURAS, SEPT. 1990
NOTE: ADJUSTMENT FACTOR INCLUDES INFLATION & PRODUCTIVITY
6 % ANNUAL INFLATION RATE
3 % PRODUCTIVITY ADJUSTMENT
OPPORTUNITY COST ESTIMATED AT 17% ANNUAL INTEREST RATE

TABLE 8. SCENARIO C. TOTAL COSTS FOR "LA FAMILIA DE LOS NUMEROS".
LEMPIRAS

ADMIN. PERSONNEL	Q	ADJUST. FACT.	1991 TOTAL COST	1992 TOTAL COST	1993 TOTAL COST	1991-1993 COMBINED
AVANCE ADM. CHARGE		1.06	54,488.62	59,341.24	66,067.97	179,897.83
SECRETARY	1	1.06	10,317.35	10,936.39	11,592.58	32,846.32
ACCOUNTANT						
MARKETING COORD.						
ASSIST. MARK						
DRIVER						
CLEANER						
GUARD						
TEMP. PERSONNEL						
SUBTOTAL A1		1.06	10,317.35	10,936.39	11,592.58	32,846.32
SUBTOTAL A2	-		64,805.97	70,277.63	77,660.55	212,744.15
TECH. PERSONNEL						
DIRECTOR	1	1.09	40,302.75	43,930.00	47,883.70	132,116.44
PRODUCTION COORD.						
SOUND TECHN.						
ACTORS						
SCRIPTWRITERS	1	1.09	18,792.69	20,484.03	22,327.59	61,604.32
EVALUATORS						
PROGRAM COORD.	1	1.09	27,228.20	29,678.74	32,349.82	89,256.76
EVALUATION COORD	1	1.09	27,239.10	29,690.62	32,362.77	89,292.49
COMPUTER ENG.						
FRINGE BENEFITS		1.06	14,400.42	15,270.80	16,187.05	45,864.27
SUB-TOTAL B			127,969.16	139,054.19	151,110.94	418,134.29
OPERATING/EQUIP.						
RENT		1.06	7,268.57	7,704.69	8,166.97	23,140.22
UTILITIES		1.06	1,948.01	2,064.89	2,188.79	6,201.69
VEHICLES						
GASOLINE		1.06	5,608.18	5,944.67	6,301.35	17,854.19
TRAVEL/PER DIEM		1.06	10,109.77	10,716.36	11,359.34	32,185.47
BLD/FURN REPAIR		1.06	1,413.33	1,498.13	1,588.02	4,499.49
VEHICLE REPAIR		1.06	7,500.94	7,950.99	8,428.05	23,879.99
EQUIP.REPAIR		1.06	1,413.33	1,498.13	1,588.02	4,499.49
STUDIO						
RECORDING COSTS						
MISCELLANEOUS		1.06	1,187.16	1,258.39	1,396.81	3,842.35
AIR TIME COST		1.06	284,080.00	301,124.80	334,248.53	919,453.33
PACKAGING/DISTR		1.06	2,436.55	2,582.75	2,866.85	7,886.15
OFF.PAPER/SUPPLIES		1.06	5,088.00	5,393.28	5,986.54	16,467.82
INSTRUCT. MATERIAL						
RADIOS			39,814.83	46,275.35	53,629.82	139,720.00
T/GUIDES			39,063.58	45,402.20	52,617.91	137,083.69
WORKBOOK			57,011.30	66,297.06	76,833.56	200,171.92
BATTERIES						
POSTER SETS			564.13	656.13	760.41	1,981.07
CARRY BAG			2,036.37	2,366.80	2,742.96	7,146.13
SUPERVISORS COMM.			568.13	621.94	681.13	1,871.20
SUB-TOTAL C			467,142.59	509,356.56	571,385.06	1,547,884.20
TOTAL COST			659,917.72	718,688.38	800,156.54	2,178,762.64
AMORTIZATION	10		693,095.30	693,095.30	693,095.30	2,079,285.90
OPPORTUNITY COST	17		112,186.01	122,177.03	136,026.61	370,389.65
GRAND TOTAL COST			1,465,199.03	1,533,960.71	1,629,278.46	4,628,438.19

SOURCE: AVANCE/S.E.I. HONDURAS, SEPT. 1990
NOTE: ADJUSTMENT FACTOR INCLUDES INFLATION & PRODUCTIVITY
6 % ANNUAL INFLATION RATE
3 % PRODUCTIVITY ADJUSTMENT
AMORTIZATION CALCULATED OVER A 10 YEAR PERIOD

RADIO LEARNING PROJECT/HONDURAS

DRAFT FINAL REPORT

Tegucigalpa, Honduras

The Radio Learning Project Consortium:
Education Development Center
Academy for Educational Development
Friend Dialogues, Inc.

Radio Learning Project/Honduras

(Technical Assistance, Educational Media Component,
Honduras Primary Education Efficiency Project/AVANCE)

DRAFT

RADIO LEARNING PROJECT/HONDURAS:

FINAL REPORT

Tegucigalpa, Honduras
September 18, 1990

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PREFACE

AVANCE (La Asociación de Promoción y Desarrollo Socioeconómico de Honduras) is a private, non-profit Honduran organization dedicated to the use of the mass media in social and economic development. AVANCE has received support from USAID/Honduras since its founding in 1985.

The Radio Learning Project/Honduras (RLP/H) provided comprehensive technical assistance to AVANCE beginning in 1986 via a USAID/Honduras buy-in.

The Radio Learning Project is a dissemination project funded by the Office of Education, Bureau for Science and Technology (S&T/ED), USAID/Washington. Terms of the RLP/H buy-in appear in Prime Contract No. DPE-5818-C-00-5059-00 between A.I.D./S&T/ED and the Education Development Center (EDC) of Newton, Massachusetts, and in related sub-contracts between EDC and the Academy for Educational Development (AED), Washington, D.C., and Friend Dialogues, Inc. (FDI), of Shelby, North Carolina.

The RLP/H contract extended from April 23, 1987, through September 30, 1990.

This report is intended to serve as a summary institutional narrative of the entire AVANCE experience from April 1987 onward, with emphasis on the interactive radio activity and technical assistance in social marketing. The report summarizes RLP/H activities; discusses lessons learned over the course of the AVANCE project; and reviews options and offers recommendations for sustaining some or all of the services developed under AVANCE's educational-radio operation.

RLP/H is copiously documented. Annual and monthly reports were submitted to USAID and the RLP consortium during 1987, and annual and trimestral reports were submitted beginning in 1988. Documentation also includes global and annual implementation plans, implementation plans and field evaluation reports by series for the interactive radio activity, and several interim special reports to USAID on the status of the radio activity and technical assistance as a whole. This documentation contains detailed descriptions and discussions of the matters summarized in this report. A list of RLP/H documentation is attached to this report as Appendix 1.

The RLP/H technical assistance team has seen many transitions and developments within AVANCE and its working environment, and, effectively, is AVANCE's institutional memory. In three and a half years, RLP/H was implemented under the tenures of four USAID\Honduras project officers, two Human Resources Division heads, two Mission Directors, three AVANCE General Managers, and

four presidents of AVANCE's Junta Directiva (Board of Directors). This staffing turnover in USAID and host country administrators inevitably resulted in policy changes and shifts in emphasis with important effects on the project. It also meant that circumstances did not permit many of the people most closely associated with AVANCE an overview of its development along its entire course.

This report aims to provide such an overview.

David C. Edgerton
Chief of Party
Radio Learning Project/Honduras
Tegucigalpa, Honduras
September 25, 1990

EXECUTIVE SUMMARY

Development of AVANCE

AVANCE was established with USAID/Honduras funding in 1985 as a private, non-profit Honduran agency for the purpose of publishing a weekly rural-development newspaper. In April, 1986, USAID/Honduras entered into a Cooperative Agreement with AVANCE which greatly expanded AVANCE's activities, including, importantly, the addition of an educational-radio operation specializing in the Interactive Radio instructional system. AVANCE's mandate was defined generally as the use of the mass media, from within the private sector, in the broad interests of education and social development. A central premise in the expansion was that the interactive radio activity would be sustained by income generated by AVANCE's other enterprises.

While the interactive radio operation developed well, AVANCE's income-generating schemes did not. From its earliest days, AVANCE was not very carefully managed, and the addition of multiple activities complicated the project's management. The USAID subsidy to AVANCE ended in mid-1990. As of this writing, the future of the AVANCE organization is uncertain.

The Interactive Radio Activity

The Interactive Radio unit itself, however, independent of AVANCE, may have arrived at the threshold of sustainability. Since the Interactive Radio operation was a demonstrably effective educational activity conducted under the AVANCE aegis, its sustainability is of particular interest.

The output of the Interactive Radio Component included La Familia de los Números, a course in mental calculation for children in grades one through three; a 100-lesson introductory English course for Spanish-speaking pre-schoolers; and several small public-interest radio series produced under commercial contracts. In late 1989 the interactive radio team began work on a primary-school reading series. An additional outcome of the interactive radio activity was the strong technical capability of its staff. By 1989 the interactive radio staff had become one of the most highly qualified technical groups of its kind in the world.

The interactive radio operation as it presently stands possesses distinct potential for private-sector sustainability. The model for sustainability which emerged with the interactive radio activity has elements in common with stable existing models in the U.S., Latin America, and elsewhere.

The elements of the model are:

1. An institutional configuration consisting of a private, non-profit charter; small size; a mandate limited to instructional, educational, and public-interest radio production; and a board of oversight consisting of members with clear professional interests in education and broadcasting.

2. Firm ties to public education, including an MOE policy commitment to the use of radio in the public school system.

3. A three-pronged capability for generating sustaining income including:

    a. Fundraising capability.
    b. Commercial sale of secondary products and spinoffs.
    c. Income from international contracts providing technical assistance for regional adaptations of programming.

Lessons Learned

1. AVANCE was overloaded, and was overburdened by the volume of its activities. The AVANCE experience confirms current trends in development away from larger, multi-purpose enterprises and towards micro- and small-scale undertakings.

2. AVANCE's governing body was flawed in its conception, in that it did not have a genuine stake in the organization's operations.

3. To succeed, any educational-technologies project requires a close, stable relationship with public education, particularly if it is conducted from within the private sector.

4. In some cases, preferring short-term to long-term technical assistance may be a false economy. Short-term technical assistance, while less costly, provides less continuity and may be less effective.

5. The radio activity's sale of radios to teachers was ill-advised. Good will would have been generated among teachers if local school boards, community or parent groups had purchased the radios. However, marketing of educational programs and products is a viable option both to improve quality and to expand the resource base.

6. In seeking private-sector sustainability for the radio component, the project developed a completely new model, although existing models were readily adaptable to its particular needs. Viable precedents for private-sector educational-media agencies exist in both the industrialized and developing worlds: the project might have drawn effectively on such models using government subsidies, commercial sales, and income-generating activities.

Recommendations

This report recommends sustaining the successful Familia de los Números radio series, together with a core professional staff of eight from the interactive radio unit. Preservation of a core staff of eight would enable the unit to sustain the Familia de los Números series and also to complete the transition to permanent, independent sustainability as a small educational-radio service agency.

This recommendation is detailed under "Option 4" in Section VI, "Options for the Interactive Radio Activity," together with an illustrative budget. Funding at about $85,000 a year over three years ($250,000 total) is recommended.

SECTION I:
THE DEVELOPMENT OF AVANCE

Origins

AVANCE, La Asociación de Promoción y Desarrollo Socioeconómico de Honduras ("The Honduran Association for Socio-economic Growth and Development") was established with USAID/Honduras funding in 1985 as a small-scale, private, non-profit Honduran agency. AVANCE's sole activity for the first two years of its existence was the publication of El Agricultor, a weekly rural-development newspaper.

The intention was to pattern El Agricultor after a long-established weekly published by Acción Cultural Popular (ACPO) in Colombia and used as an element in rural adult-literacy and community-development activities. Assistance in setting up the El Agricultor operation was provided to AVANCE in 1985 and 1986 by ACPO technicians.

AVANCE is instituted under a governing Assembly of thirty-nine business leaders. This Assembly elects from its membership a nine-person Board of Directors charged with oversight of AVANCE's operations.

Expansion

In April, 1986, USAID/Honduras entered into a Cooperative Agreement with AVANCE, which was designed to greatly expand AVANCE's activities as a private, non-profit undertaking. The Agreement provided funding through 1992, and technical assistance through 1990. Existing and contemplated activities in addition to El Agricultor included Sani Radio, a short-wave community radio station in the Moskitia; two commercial "quick-print" shops; a rotary press; a marketing agency; and, an educational-radio operation specializing in the Interactive Radio Instructional system.

AVANCE's Private-sector, Public-service Mandate

Under the 1986 Cooperative Agreement, AVANCE's mandate was defined generally as the use of the mass media, from within the private sector, in the broad interests of education and social development. Under the agreement, AVANCE was required to develop financial self-sufficiency, independent of continued USAID funding, by the projected 1992 end-date.

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AVANCE's administration responded with a set of ambitious income-generating schemes. AVANCE believed that El Agricultor could become profitable if it were made more commercial, although this enterprise has not achieved profitability over its four-year history. It was envisioned that by the end of 1988 AVANCE would be operating a rotary press at a profit; that the Marketing Division would generate revenues from the sale of commercial marketing services; that the quick-print operation would flourish; and that Sani Radio would bring in income from advertising and from private foundation grants.

AVANCE and Interactive Radio

Definition

"Interactive radio" is a distance-learning system being used increasingly in the developing world to provide courses of study by radio to young children. The system is an effective and comparatively inexpensive way to give children in marginal educational settings access to instruction of high quality. Interactive radio has been shown to result in sharp increases in student achievement. An interactive radio series is generally treated as a teacher's instructional tool -- that is, teachers receive broadcasts each day on portable radios in their classrooms, supervising their use as they would any other classroom materials. The system has also been used successfully to provide basic, nonformal schooling to children in communities without schools or trained teachers.

The Decision to Locate Interactive Radio in AVANCE

Interactive radio was one of seven interventions which together comprise the Primary Education Efficiency Project, a broad-based educational-reform effort initiated by USAID/Honduras in 1986 and now in its final stages.

The interactive radio activity was separated out from the other six and instituted in the private sector under the aegis of AVANCE.

The arrangement with AVANCE came about in part simply because USAID viewed AVANCE as a convenient institutional home for interactive radio. The Ministry of Education agreed willingly to cooperate with an interactive radio undertaking, but did not want the activity directly within its purview, perceiving that it probably could not have successfully set up or managed a public-sector school-broadcast operation.

USAID also viewed the marriage of interactive radio to AVANCE as the centerpiece in an opportune experiment in privatization.

Interactive radio, it was decided, would be AVANCE's formal educational enterprise, the principal effort in addressing the Cooperative Agreement's dual mandate to serve education and also to sustain itself financially. The expectation was that AVANCE would be able to sustain interactive radio with revenues generated by the other activities. Though the interactive radio operation would raise some income through sales of radio receivers and related print materials, and through commercial sponsorship, both USAID and AVANCE's administration believed that the interactive radio operation would always depend on AVANCE's net solvency to sustain it.

The radio receivers were marketed directly to teachers. Commercial soft-drink sponsorship was obtained for the student workbooks and classroom posters that were used with the interactive radio programming. Airtime was donated by the country's two largest private broadcast networks.

During the first project year, the possibility of autonomous sustainability for the interactive radio operation, independent of AVANCE's other operations, was not considered, in spite of the relatively plentiful existence of models for self-sustainability in public-interest broadcasting.

The interactive radio operation developed well (see also Section III). Sani Radio enjoyed continuing popularity among the minority-ethnic populations it was designed to serve. The increasingly attractive El Agricultor found a steady audience among teachers and was widely used in rural schools. However, while the project's activities generally succeeded in technical terms, AVANCE's money-making schemes did not. None of the activities sustained themselves financially. The management of AVANCE had not been fully effective before the 1986 Cooperative Agreement, and the sudden increment of diverse activities only made matters worse.

In mid-1990, the USAID subsidy to AVANCE ended, two years before the end-date contemplated in the Cooperative Agreement. As of this writing, the future of the AVANCE organization is uncertain.

However, the interactive radio unit itself, independent of AVANCE, may have arrived at the threshold of sustainability. Since the interactive radio operation was a demonstrably beneficial educational intervention (see also Section III), its sustainability is of particular interest in regard to education sector development. The potential private-sector sustainability of the interactive radio activity is of interest also because it is the only viable private-sector sustainability model to have emerged from the AVANCE experiment in privatization.

The matter of sustainability for the radio activity is discussed in detail in the following sections.

SECTION II:
SUMMARY DISCUSSION OF RLP/H ACTIVITIES

General

The 1986 Cooperative Agreement earmarked technical assistance for all AVANCE operations, including extensive assistance in administration, management, and marketing, at $2.16 million over four years (1986-1990). This entire amount was spent over the period of the contract. Over half the amount ($1.5 million) was spent on technical assistance to the interactive radio operation. The remaining funds were spent on technical assistance in marketing, management, financial planning, cost accounting, and fundraising, and on miscellaneous assistance to the El Agricultor, Sani Radio, and Impresiones Laser (quick-print) operations.

RLP/H was responsible for providing and managing all technical assistance and services, with emphasis on small, precise applications of short-term TA.

Long- and Short-term TA

RLP/H provided two long-term technical advisors: the Chief-of-Party and Radio Education Advisor, for a period of 3.5 years (the entire course of the RLP/H contract); and a Social Marketing Advisor for a period of two and one-half years.

Intensive short-term technical assistance in the development of AVANCE's flagship interactive radio undertaking, the Familia de los Números mathematics series, was provided over the life of the project by an RLP Subcontractor, Friend Dialogues of North Carolina, Inc.

Documents, beginning with the Primary Education Efficiency Project Paper on, call for emphasis on short-term technical assistance. This emphasis was honored in the configuration of RLP/H technical assistance. The emphasis on short-term technical assistance is discussed under Section V, "Lessons Learned."

Technical Assistance to the Interactive Radio Component

The development of the Interactive Radio Component of the Primary Education Efficiency Project was the central RLP/H activity. Its planning and execution are chronicled in great detail in project documentation. The outcomes of technical assistance to the interactive radio activity are (1) the products and services of the

Interactive Radio Component, and (2) the Interactive Radio Component Staff (Section III).

In addition to the daily work of the RLP/H Chief-of-Party/Radio Education Specialist and of Friend Dialogues, short-term technical assistance, largely concentrated in the first eighteen project months, was provided in interactive-radio systems management, scriptwriting, studio design and installation, and audio production.

Technical Assistance in Social Marketing

Strengthening the marketing and business planning capabilities of AVANCE was a second major objective of technical assistance. Besides assignment of a long-term technical advisor in communications and social marketing, RLP/H responded to a number of requests from AVANCE and USAID for technical assistance in marketing strategy planning, marketing research, business planning and management, financial planning, and all aspects of newspaper publication from design to editorial policy to distribution. (See also Appendix 2, Summary List of RLP/H Short-term Technical Assistance.)

Other Activities

Procurement

RLP/H, in collaboration with the USAID/Honduras Mission, assisted AVANCE extensively in commodities procurement. This work included procurement of an audio production facility (see following paragraph), computer equipment, radio receivers, tapes, and bulk newsprint. EDC and FDI provided substantial procurement assistance, also serving in an advisory role regarding procurement.

Studio Design and Installation

RLP/H designed and supervised the installation of a small audio production facility for the Interactive Radio Component, designed a sophisticated multi-track recording facility, and initiated procurement procedures for the multi-track facility under a USAID/HRD funding earmark which was approved but later cancelled.

Computer systems

RLP/H designed, procured, and installed AVANCE's personal-computer system, and trained the staff in its use. FDI support was extensive in this regard and involved several staff visits.

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Familia de los Números Summative Evaluation

RLP Subcontractor Friend Dialogues (FDI) planned and coordinated an exhaustive longitudinal summative evaluation of the Familia de los Números series, conducted by the interactive radio component staff with support and additional partial funding provided by the Radio Learning Project. FDI's final report on the Familia de los Números summative evaluation will appear following administration of third-grade tests by the interactive radio component staff in November of this year.

Mid-point Testing in Mental Calculation

At the end of 1988, RLP provided funding for a special mid-point pilot-phase mental-arithmetic testing activity. This testing figured importantly in instructional design work on the Familia de los Números series. The purpose of the testing was to compare the abilities of experimental and control (user-and non-user) groups of children in mental calculation. Children who had been tested in 1987 were compared with children who had radio lessons in 1988. The children who had received traditional instruction averaged 34% correct on the first-grade posttest in 1987. During the following year, both radio instruction and new textbooks were supplied to the same classrooms, and the children averaged 52% correct, a very large gain of 18%. (A more detailed report of the first-grade summative evaluation is provided in Friend, "Trip Report," 20 January, 1989, and in Friend, "Evaluation of La Familia de los Números, First Grade," 29 September, 1989.)

Solar-powered Radio Receiver Experiment

In 1989 and 1990 the Radio Learning Project arranged and funded a small-scale solar-powered receiver experiment using ten experimental Interactive Radio Component schools. An interim report of the solar-powered radio experiment indicated that more work was required to present a clear indication of the cost benefits of solar-powered radios. While cost savings were significant, usage limitations (fixed location, weather), and economic questions (who pays, who benefits) were hard to quantify. (See C. Friend, "Alternative Power Sources: Final Project Report," September, 1990.)

Conferences

The Second Latin American Conference on Interactive Radio:

RLP funded, and co-sponsored with USAID and AVANCE, the Second Latin American Conference on interactive radio in Tela, Honduras, November 14-18, 1988. The first interactive radio conference was hosted by the Radio for Community Education (RADECO) Project in

1984. The second conference was a major collaborative occasion involving countries using or contemplating use of the interactive radio system. Delegates from twelve Latin American and Caribbean nations, Kenya, Malawi, Swaziland, and Nepal attended. Besides reports from each radio site, delegates participated in some fourteen technical workshops covering instructional design, evaluation, studio production, planning and management; and funding, community development, and institutional aspects of interactive radio. Delegates formed a commission on interactive radio instruction calling for followup to the conference and leading to several inter-regional meetings on topics of interest.

Regional Conference on Collaborative Program Development:

In September, 1989, RLP funded and sponsored one of these followup sessions, a two-day regional conference/workshop at the AVANCE offices on collaboratively-developed interactive radio programming. Representatives from Honduras, Guatemala, Costa Rica, Ecuador, Bolivia, El Salvador, and the Dominican Republic discussed ways of replicating and adapting programming, undertaking regional cooperative development projects, and otherwise sharing production costs and resources among nations using the interactive radio system. Three options were developed, each recommended for varying needs and funding available: major adaptation that retains only the instructional design; adaptation that maintains a regional context; and, minimal adaptation of country or producer identification. (See Corrales, "Regional Radio Programming for Latin America," Radio Learning newsletter No. 3, March, 1990.)

Fundraising

RLP/H took the position that AVANCE should develop strong, independent fundraising capability, particularly in the area of educational and public broadcasting, as an aspect of efforts to sustain Sani Radio and the interactive radio Activity. RLP/H arranged for AVANCE membership in the Resource Foundation, a New York-based non-profit agency which specializes in helping developing-nation PVO's develop fundraising capability. Fundraising is discussed further in Section III under "Sustainability."

Sponsorship of International Relationships

RLP, and especially the Consortium's Prime Contractor, the Education Development Center in Newton, Massachusetts, figured importantly in AVANCE's international relationships with Costa Rica and Belize (see also Section III), facilitating arrangements and funding the acquisition by those countries of technical services from the AVANCE interactive radio Unit.

A summary list of RLP/Honduras short-term technical assistance is attached as Appendix 2.

SECTION III:
INTERACTIVE RADIO: OVERVIEW OF SERVICES AND ACTIVITIES

The Interactive Radio Component's first undertaking was La Familia de los Números, a course in mental calculation for children in grades one through three.

The Project Paper called for the Interactive Radio Component to replicate Radio Mathematics, the original interactive radio series, which had been developed in Nicaragua during the 1970's. Radio Mathematics/Nicaragua was a complete, largely self-contained course. USAID/Honduras, however, was simultaneously funding development of a new textbook-based elementary mathematics curriculum under another of the Primary Education Efficiency Project's components. Consequently, replication of the Nicaragua mathematics series would have instituted two competing math curricula in Honduras.

AVANCE avoided this conflict by developing a course designed to complement textbooks and develop children's mental calculation skills. The "Mental Arithmetic Curriculum for Honduras" was designed by Jamesine Friend, the instructional systems designer who had directed the Nicaragua Radio Mathematics Project. The course is completely independent, in that it does not require the classroom teacher to teach concepts before they are needed in the radio exercises. Concepts that are needed in the mental arithmetic course are developed within that course. (It is assumed that classroom teachers continue to teach the regular mathematics curriculum using the textbooks.) As the mental arithmetic course is self-contained, it can be characterized as "generic" and is suitable for use as a complement to any standard textbook.

The mental arithmetic curriculum is organized both by arithmetic topic and by the cognative skills to be taught. The arithmetic topics taught include work in the areas of numbers, addition, subtraction, multiplication, division and combined operations. For each of these topics, a number of different kinds of cognitive skills are taught. These skills are grouped into the following classes: naive applications, concepts, language, algorithms, proofs, problem solving, estimation and memorization. A description of the program and the "Master Plan" can be found in Friend, "Proposal for a Mental Arithmetic Curriculum," 11/87, and other documents cited in Appendix 1.

As a result of the "generic" design, AVANCE began for the first time to consider the possibility that the Interactive Radio Component might actually generate income. Since it was designed to

be used with any standard textbook, the series could be easily adapted for sale to other Spanish-speaking countries.

La Familia de los Números is a markedly effective original interactive radio course. First-year summative results showed 18% (0.8 effect size) gains in experimental-group over control-group test scores. The experimental group included new radio programs, plus new textbooks, and limited teacher training. The additional impact of the radio series alone was substantial, with an effect size of .37. Second-year results were even higher with the radio programs, resulting in an effect size of .61. 1988 AVANCE market research showed solid rates of acceptance among teachers. La Familia de los Números is in use by approximately 196,000 students and their teachers in 6,000 Honduran classrooms, presently the largest interactive-radio user population in the world for a single series.

By the end of 1988, the 17-person AVANCE interactive radio staff was by all measures a most highly qualified technical group. Over three years of intensive work, production never fell behind schedule and production levels were very high. The staff's productivity, measured in programming output, was the highest of any interactive radio undertaking in the history of the system. The Familia de los Números formative-evaluation component, the key element in the instructional effectiveness of interactive radio, was particularly strong.

In January, 1988, AVANCE installed a fully-professional small audio recording facility in the Interactive Radio Division offices. In the same year the Division began conducting the cycle of design, scriptwriting, and formative evaluation feedback on personal computers. This was the first complete computerization of an interactive radio design-and-production operation in the history of the system.

Also in 1988, AVANCE initiated an adaptation of the Kenya Radio Language Arts Project, an interactive radio course in English as a second language for children in grades one through three, developed in the Republic of Kenya during the early 1980's. The result, Aprendamos Inglés ("Let's Learn English"), a 100-lesson introductory English course for Spanish-speaking preschoolers, was the Interactive Radio Unit's first attempt at a commercial venture. AVANCE piloted the series among Hispanic minority populations in nearby Belize. The interactive radio Unit's marketing staff prepared a commercial package of the series on cassette, and AVANCE provided the materials and technical assistance for a Belize pilot project. It is anticipated that Belize will purchase the full series for adaptation and use there. Also, with funding and support from the Radio Learning Project, AVANCE sold a technical-assistance package to Costa Rica for adaptation and use of La Familia de los Números.

By the first months of 1989, in addition to the mathematics and English series, the Interactive Radio Unit was at work on two small public-interest radio series: Naislavila, a fifty-program series on small-scale agriculture, produced as an AVANCE intra-agency service for Sani Radio; and a twelve-program information series on small-business development, produced under commercial contract for PYME, a private-sector business-development project.

In late 1989 the interactive radio Component began work on Radio Español, a major new interactive radio series in reading, designed to complement the reading texts developed by the Primary Education Efficiency Project's textbook component. Over the first half of 1990, the radio staff conducted thorough baseline research and developed a preliminary instructional design for the new series.

AVANCE's interactive radio operation was developing the contours of a permanent, self-sufficient institution: professional recording capability; computerized instructional design; commercial contracts; growing international connections; growing sophistication in field research; and, a dedicated, highly qualified staff.

Some implications of the Interactive Radio Component's institutional profile are discussed in the following section.

SECTION IV
DISCUSSION: THE HONDURAS INTERACTIVE RADIO COMPONENT AS A MODEL FOR PRIVATE-SECTOR SUSTAINABILITY

The Problem of Sustainability

Users of the interactive-radio system face a problem common to many development technologies, even "low-tech" interventions like interactive radio: sustainability.

Use of interactive radio begins with a donor agency providing up-front funding to produce a pilot interactive-radio series tailored to address specific needs. At the end of the pilot project, a collection of five hundred or so carefully-designed broadcast recordings is in place. The funding also supports the establishment of a small educational-media agency, consisting of a recording studio, a computerized design operation, and a staff of ten to twelve host-country technicians trained and experienced in making children's instructional radio programming.

The objective is that the host country be able to then either sustain the production unit intact as a permanent school-radio service, or simply arrange to keep the pilot series on the air. The cost calculations of keeping the pilot series in use often totals about a dollar per child per year. Sustaining the production operation as a permanent agency might cost an additional one hundred thousand dollars per year. But, many less-developed nations barely manage to meet the costs of keeping public primary schools open at all, and often in chronic states of financial distress.

The challenge, then, is to find ways for less-developed nations to sustain even such low-cost, appropriate-technology systems as interactive radio once pilot development projects have set them up.

Private-sector Sustainability and the AVANCE Experiment

Previous to the AVANCE interactive-radio activity, most interactive-radio projects had been focused on methodology and materials development, rather than institution-building. Though conceived with hopes of institutionalization in some form, all had been public-sector interventions, run from within ministries of education or ministry-run school-media offices.

As the first experiment in sustainability in the history of the system, the AVANCE Interactive Radio Component produced a model for sustaining education-media and other small- and medium-scale appropriate-technology projects.

That it did so within AVANCE, while overcoming management and operations problems, suggests that the model is natural to projects of its size and type, and that it is relatively resilient.

In fact, nothing in the model is radical or even unusual (see Section V, "Lessons Learned"). In developing and industrialized nations alike, instructional radio and television services are commonly provided to public education from the private sector via some stable ongoing arrangement between the private and public sectors. Elements of the model can be found in media agencies in Latin nations; in systems common among state school television agencies in the U.S.; and in the fundraising and income-generating practices of the most successful agency in the history of educational broadcasting, the Children's Television Workshop.

The model consists, essentially, in establishing a small, independent, private, non-profit agency with a three-pronged capability for generating sustaining income. The three elements are:

a. Fundraising to cover program development costs.

Public-interest broadcast production of any kind must always be subsidized. In the British and French models, the tradition of government subsidy of broadcasting in the public interest assumes powerful cultural proportions. In the U.S., the practice of corporate grants to public-interest broadcasting is supported by tax advantages and growing tradition. In the developing-world version of the U.S. model, international donor agencies substitute for corporate grant sources.

Although AVANCE's fundraising skill remained largely undeveloped, RLP/H and USAID recognized the importance of fundraising to the sustainability of the interactive radio Activity.

b. Commercial sale of secondary products and spinoffs.

Sesame Street product spinoffs are a famous example of this standard pattern for income generation. Media popularity even on a small scale can lead to profitable product spinoffs and secondary-product campaigns. The Familia de los Números series enjoys wide broadcast coverage and a large listenership. There is no reason why profitable spinoffs should not result from a popular school-broadcast series.

The sale of radios to teachers, while problematic (see "Lessons Learned"), was a step in the right direction. The Interactive Radio Component's Cancionero (songbook) was exactly the right idea. That it was not vigorously marketed was a problem common to all of AVANCE's components and

symptomatic of AVANCE's institutional weaknesses, and does not diminish the value of the idea of media product spinoffs per se.

c. Income from international contract packages providing broadcast rights and technical assistance for regional adaptations of programming.

Beginning nearly two decades ago, the Children's Television Workshop uncovered a vastly profitable market niche for itself in the sale of sophisticated technical-assistance and rights packages for international adaptations of Sesame Street. On a far more modest scale, but appropriately and impressively, the AVANCE interactive radio operation developed regional international contacts with very hopeful potential for enhancing sustainability.

SECTION V:
LESSONS LEARNED

1. AVANCE was overloaded.

AVANCE was essentially used as a convenient repository for miscellaneous human-resources activities. Sani Radio and the interactive radio activity would each have been better off instituted independently, each with a case-specific mandate and a small governing board consisting of people with specific regional or technical interests in those projects' operations.

The other cause of the overloading was AVANCE's increasingly intense search for ways to make money. The Impresiones Laser operation, for example, was not a well-fitted addition to an education project.

AVANCE was overburdened by the volume of its activities. The AVANCE experience confirms current trends in development away from larger, multi-purpose enterprises and towards micro- and small-scale undertakings.

2. AVANCE governing body was flawed in its conception.

Because it was composed of local business leaders rather than educators, AVANCE's Board of Directors did not have a genuine stake in the agency's educational operations. As a result, the actions of AVANCE's Board were sometimes contrary to the organization's educational endeavors. AVANCE's technical operations frequently found themselves at odds with their own Board of Directors.

This is a key lesson to be learned from the AVANCE experience. The interactive radio operation would have been more effective if it had been established as an independent institutional entity, rather than being inserted into a larger existing institution. Further, its effectiveness also would have been enhanced had it been governed by an oversight body consisting largely of educators, professional broadcasters, and others with a genuine professional stake in project operations.

An interesting alternative for developing nations with stable higher academic institutions would be an educational-technologies project instituted as an operation within a college or university. Several established school-television agencies in the U.S. are operated from the campuses of state universities, enjoying the benefits of proximity to the university's creative and academic resources. In Mexico, Chile, and Colombia, and in many places in Africa and Asia, there are strong connections between universities and public-interest broadcasting.

3. To succeed, an educational-technologies project requires a close, stable relationship with public education.

Experimental introduction of an innovation into a nation's schools requires the cooperation of the office of government that administers public education. Sustained use of the innovation depends on its thorough and willing institutional incorporation into public education. Honduras' Ministry of Education has always behaved cooperatively toward the interactive radio activity; but institutionalizing interactive radio will require an MOE policy commitment in the near future, and, at this late hour, the position of the MOE is unclear.

This is mainly so because the radio activity lost strong, built-in ties to the Ministry and to the larger educational and academic community in Honduras when AVANCE dismissed General Manager Carleton Corrales, a highly regarded professional educator who has a long-standing relationship with the formal education establishment. The institutionalization of the radio activity is a good deal less certain in his absence. AVANCE's principal purpose was to provide services to public education; but in dismissing Dr. Corrales, AVANCE effectively cut its ties to public education.

The lesson to be learned here is that the importance of institutional ties between an innovation project and its corresponding public institution should always be among developers' main considerations during the pilot phase, especially if the pilot activity is conducted from within the private sector. There is a need for developing political support and commitment in the form of an MOE budget allocation for sustaining the use of radio once the development phase is over. A private agency can develop the program, but the user (MOE) must be able to continue use with its own funding.

4. In some cases, preferring short-term to long-term technical assistance may be a false economy.

RLP/H followed a current USAID trend toward favoring short-term over long-term TA. USAID's own mid-term evaluation, however, commented that short-term TA to some extent seemed scattered and ineffectual, particularly in the areas of management, administration, and marketing. The implication in the mid-term evaluation seemed to be that the short-term TA lacked programmatic or thematic continuity.

The advisors themselves, the selection of advisors offered by RLP/H, or AVANCE's inability to absorb technical assistance in management and administration, could all be factors in reducing the effectiveness of short-term TA. On the other hand, short-term TA

may have been less effective, to an extent, simply because it was too short. The solution would seem to be either longer short-term tours, perhaps measured in months rather than weeks, or increasing use of long-term TA. A recognized liability of long-term TA is that it is more expensive than short-term TA; also, a bad long-term advisor is a more serious investment loss than a bad short-term advisor. Carefully chosen long-term advisors, however, can provide the continuity that short-term TA generally lacks.

5. The sale of radios to teachers was ill-advised.

AVANCE's sale of radios to Honduras' impoverished rural teachers resulted in unnecessary ill-will, particularly among Honduras' left-leaning and already-suspicious teachers' organizations. Early research with Honduran teachers had shown them to be resistant to change in a methodology they had traditionally used: teachers were concerned both about reliability of the new program and about the effort (and expenditure) they would have to put forth. Teachers did not feel initially that there should be a need to pay for the program, either on their part or on the part of the community. They felt that soliciting parent and community support would make them responsible for the unknown "product" being introduced. (See also "Results of the Qualitative Study for the Program of Educational Interactive Radio.") The radios should have been sold to patronatos (local school boards) and other rural community and civic groups, via an outreach and support program for those groups, thereby reducing the teachers' responsibility for introduction of the new technology.

Alternatively, AVANCE could have invested in outreach aimed at developing parents' groups for the purpose of buying the radios and supporting the use of the programming. Similar outreach programs have been used successfully elsewhere in interactive radio programs. Outreach programs are a proven means of carrying out rural materials distribution. Such a program would have been entirely acceptable in Honduras, including among teachers. It would have offered the additional benefit of strengthening rural community institutions, and probably would have met with equal success in the income-generating sale of radios.

6. In seeking private-sector sustainability for the radio component, the project developed a completely new model, although existing models were readily adaptable to its particular needs.

There is apparently no precedent in development for what the AVANCE organization evolved into -- a multi-function non-profit media agency working at a variety of disparate simultaneous educational undertakings and money-making ventures. That no such precedent

exists is not surprising. The closest multi-function model, Colombia's Acción Cultural Popular (ACPO), first, was a great deal more focused than AVANCE in its instructional goals and, second, always relied on skillful, concerted, and successful international fundraising efforts.

There are, however, models both in the developing and industrialized worlds for private-sector sustainability for small school-broadcasting agencies and other small-scale and medium-scale single-purpose educational-technology enterprises (see Section IV, above).

These models were known when AVANCE was planned. The decision to insert the radio activity into AVANCE, rather than instituting it independently, was based on two key assumptions. First , it was assumed that the existing AVANCE organization resembled a school media agency closely enough to substitute for one. It was also assumed that AVANCE would thrive with the addition of multiple function. Both these assumptions proved to be erroneous.

The problem was compounded, in the case of the radio activity, by not removing the activity from AVANCE immediately when it became apparent that the AVANCE Board had no real interest in it.

Now, however, that removal and an appropriate continuation of radio services and/or activities can be effected. Options for continuation of some or all of the interactive radio activity's services and activities are the subject of the following section.

SECTION VI:
OPTIONS FOR THE INTERACTIVE RADIO ACTIVITY

General Discussion

The Familia de los Números series is an interventior of proven educational value. The AVANCE interactive radio Oı ·ation in Honduras is most capable and active. Means should be found to sustain both aspects of USAID's investment.

A range of options, from archival preservation of the series' files and tape collection, through full institutionalization of Honduras' interactive-radio service capacity, are discussed below in ascending order of complexity and preferability.

Illustrative budgets assume funding from a single source. All the options, however, assume some form of MOE involvement. Options 1 and 2, for example, assume that MOE would provide office space. Costs to USAID in any of the options would be reduced, of course, by increased MOE levels of involvement. In any of the options, for example, MOE might provide some or all professional staff salaries, clerical support, or office supplies.

The options all assume that essential project equipment -- the recording studio and personal-computer system -- is under the control of the AVANCE Board of Directors and lost to the project. If this is not the case, and that equipment could in fact be recovered from AVANCE, costs would be reduced accordingly.

The RLP/H technical assistance team recommends that any further relationship with AVANCE in sustaining interactive radio services not be contemplated. However, it does recommend that every possible effort be made to secure master copies of the radio activity's recordings, and, if feasible, to arrange for transfer of the studio and computers to the MOE or elsewhere.

Tape needed for the immediate requirement of protecting and preserving the existing collection of radio activity recordings is shown in Table 2, immediately below.

TABLE:
BREAKDOWN OF TAPE REQUIREMENTS (ALL OPTIONS)
FOR PRESERVING THE COLLECTION OF RECORDED RADIO ACTIVITY MATERIAL

1/4" 1/2-HR OPEN REEL:	# OF TAPES:
Fam. Numeros - master, Grade 1	155
Fam. Numeros - backup, Grade 1	155
Fam. Numeros - master, Grade 2	155
Fam. Numeros - backup, Grade 2	155
Fam. Numeros - master, Grade 3	155
Fam. Numeros - backup, Grade 3	155
Master, FN teachers' broadcasts	5
Backup, FN teachers' broadcasts	5
Aprendamos Ingles - master	100
Aprendamos Ingles - backup	100
Naislavila - master	52
Naislavila - backup	52
PYME - master	12
PYME - backup	12
Music, FX, miscellaneous	50
Contingency	50
OPEN-REEL TAPE TOTAL:	1,368

30-MIN CASSETTES:	# Cassette Tapes
FN Grade 1 (2 copies/lesson)	155
FN Grade 2 (2 copies/lesson)	155
FN Grade 3 (2 copies/lesson)	155
Aprendamos Ingles (2 copies/lesson)	100
Naislavila (1 copy/program)	52
PYME (1 copy/program)	12
Music, FX, miscellaneous	25
Contingency	25
CASSETTE TOTAL:	679

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Options

Option 1:
Preservation of Files and Tapes

Staff:

1 professional
1 secretary

Total staff: 2

Recommended professional: Mario Ramírez
(Interactive Radio Component Instructional Design Coordinator)

Equipment:

1 XT-class personal computer, 20 mb hard disk, monitor, 24-pn dm printer, software
4 four-drawer filing cabinets
1 4'x 8' locking cabinet
Approximately 8' x 12' open metal utility shelving
Minimal office supplies
1,150 30-minute open-reel studio tapes
600 30-minute cassette tapes

Office space:

1 office
1 secure, air-conditioned store-room or large closet

Other costs:

Tape copying services
Computer maintenance

Discussion:

Option 1 would preserve the existing tape collection, computer files, and hard-copy technical files, retain one professional staffer half-time and one half-time secretary to interpret the material to MOE and to field requested resources from it (e.g., evaluation data, instructional-design documents).

This minimal option makes sense only as an office within the Ministry of Education. Its value to the Ministry would be that the materials would be available for reference and preserved for possible future implementation, and that Ramírez would be available to the MOE as an instructional-systems specialist.

Master and backup open-reel copies and two cassette copies (four copies total) should be made of every tape in the Familia de los Números collection, and standby arrangements for tape dubbing made with a local audio technical facility. (This requirement remains constant for all options).

MOE would certainly need to retain Ramírez half-time for other work in the Ministry in order to persuade him to accept the half-time radio position.

In the illustrative budget shown here, MOE provides office space and the half-time complement to Ramirez' salary.

RLP/H RECOMMENDATIONS FOR SUSTAINING INTERACTIVE RADIO SERVICES
OPTION 1: ILLUSTRATIVE BUDGET

	1991	1992	1993	SUBTOTAL:
STAFF				
1 Professional (half-time)	$3,900.00	$4,290.00	$4,719.00	$12,909.00
1 Secretary (half-time)	$1,950.00	$2,145.00	$2,359.50	$6,454.50
Staff subtotal:	$5,850.00	$6,435.00	$7,078.50	$19,363.50
EQUIPMENT				
1 computer/peripherals	$2,000.00	$0.00	$0.00	$2,000.00
Filing cabinets	$450.00	$0.00	$0.00	$450.00
Locking cabinet	$200.00	$0.00	$0.00	$200.00
Utility shelving	$200.00	$0.00	$0.00	$200.00
Minimal office supplies	$300.00	$330.00	$363.00	$993.00
Open-reel tape	$2,875.00	$0.00	$0.00	$2,875.00
Cassette tape	$1,200.00	$0.00	$0.00	$1,200.00
Room air conditioner	$500.00	$0.00	$0.00	$500.00
Equipment subtotal:	$7,725.00	$330.00	$363.00	$8,418.00
OFFICE RENTAL*				
1 office	$0.00	$0.00	$0.00	$0.00
Tape storage room	$0.00	$0.00	$0.00	$0.00
Office rental subtotal:	$0.00	$0.00	$0.00	$0.00
OTHER COSTS				
Tape copying service	$250.00	$275.00	$302.50	$827.50
Computer maintenance	$250.00	$275.00	$302.50	$827.50
Telephone, utilities*	$0.00	$0.00	$0.00	$0.00
Incidental/contingency	$200.00	$220.00	$242.00	
Other costs subtotal:	$700.00	$770.00	847.00	$2,317.00
YEARLY SUBTOT, GRAND TOT:	$14,275.00	$7,535.00	$8,288.50	$30,098.50

* Provided by MOE

Option 2:
Minimal Preservation of the Technology

Staff:

2 professionals
1 secretary

Total staff: 2

Recommended professionals:
Mario Ramírez
Gloria Gamero (Interactive Radio Component Evaluation Coordinator)

Discussion:

Equipment, office space, other costs, and budget assumptions are the same as in option 1.

With the addition of Lic. Gamero, however, the full instructional design capability of the interactive radio system is preserved. The two complement each other technically: Ramírez can design and write programming, but is not experienced at running a formative-evaluation operation. Gamero is skilled at evaluation, which is the key to ensuring the system's instructional effectiveness, but is inexperienced at design and script-development.

Together, Ramírez and Gamero could re-construct an interactive-radio operation at a future date. They could probably also manage to keep the Familia de los Números series running, but with the likelihood of considerable difficulty. The task of keeping the series on the air would be better managed, with little risk of serious problems, by a professional staff of four (option 3).

RLP/H RECOMMENDATIONS FOR SUSTAINING INTERACTIVE RADIO SERVICES
OPTION 2: ILLUSTRATIVE BUDGET

	1991	1992	1993	SUBTOTALS:
STAFF				
2 Professionals (full-time)	$15,600.00	$17,160.00	$18,876.00	$51,636.00
1 Secretary (full-time)	$3,900.00	$4,290.00	$4,719.00	$12,909.00
Staff subtotal:	$19,500.00	$21,450.00	$23,595.00	$64,545.00
EQUIPMENT				
1 computer/peripherals	$2,000.00	$0.00	$0.00	$2,000.00
Filing cabinets	$450.00	$0.00	$0.00	$450.00
Locking cabinet	$200.00	$0.00	$0.00	$200.00
Utility shelving	$200.00	$0.00	$0.00	$200.00
Minimal office supplies	$300.00	$330.00	$363.00	$993.00
Open-reel tape	$2,875.00	$0.00	$0.00	$2,875.00
Cassette tape	$1,200.00	$0.00	$0.00	$1,200.00
Room air conditioner	$500.00	$0.00	$0.00	$500.00
Equipment subtotal:	$7,725.00	$330.00	$363.00	$8,418.00
OFFICE RENTAL*				
1 office	$0.00	$0.00	$0.00	$0.00
Tape storage room	$0.00	$0.00	$0.00	$0.00
Office rental subtotal:	$0.00	$0.00	$0.00	$0.00
OTHER COSTS				
Tape copying service	$250.00	$275.00	$302.50	$827.50
Computer maintenance	$250.00	$275.00	$302.50	$827.50
Telephone, utilities*	$0.00	$0.00	$0.00	$0.00
Contingency	$400.00	$440.00	$484.00	$1,324.00
Other costs subtotal:	$900.00	$990.00	$1,089.00	$2,979.00
YEARLY SUBTOT, GRAND TOT:	$28,125.00	$22,770.00	$25,047.00	$75,942.00

* Provided by MOE

Option 3:
Continuation of La Familia de los Números

Staff:

4 professionals
1 secretary

Total staff: 5

Recommended professionals:
Mario Ramírez
Gloria Gamero
Marizela Turcios (Interactive Radio Component Director)
Conni Rosales (Studio Production Unit Head)

Equipment:

2 XT-class or better personal computers, each w/20 mb hard disk, monitor, 24-pin dot-matrix printer, software
1 office typewriter
1 4'x 8' locking cabinet
Approximately 8' x 12' open metal utility shelving
Office furniture
Office supplies
1,150 30-minute open-reel studio tapes
600 30-minute cassette tapes
Two 2-track 1/4" open-reel studio tape playback units with full-fidelity speakers
1 2-chamber studio cassette player with high-speed dub function
1 Tape splicing block

Office space:

Office for 4 professional staff,
Secure, air-conditioned tape-storage room with work area for Production Staff Member

Other costs:

Airtime
Tape copying service
Replacement tape
Miscellaneous tape editing and maintenance supplies
Local transportation
Mail and communication
Contingency studio time

Discussion:

This is the optimal staff for maintaining the Familia de los Números series on the air.

This option can keep the service on the air, but not distribute radios or provide other field outreach services.

Airtime costs are extremely variable in Honduras, as elsewhere in Central America. Effective negotiation for airtime would be one of Lic. Turcios' main responsibilities. Given the continuing popularity of the Familia de los Números series, the radio activity's good standing in the local broadcasting profession, and the Ministry's active support, it seems likely that she could find good prices, if not outright donations, for airtime into the indefinite future. The figure shown on the "Airtime" line in the illustrative budget, in any case, is an extremely rough estimate.

The "local transportation" and "mail and communication" lines are for regular tape delivery and pickup to and from a broadcast station or stations. This allows both for the likelihood that all the broadcasting can be conducted via the Tegucigalpa-originated national networks and for the possibility that regional station coverage might be needed.

RLPAI RECOMMENDATIONS FOR SUSTAINING INTERACTIVE RADIO SERVICES
OPTION 3: ILLUSTRATIVE BUDGET

	1991	1992	1993	SUBTOTALS:
STAFF				
4 Professionals	$31,200.00	$34,320.00	$37,752.00	$103,272.00
1 Secretary $3,900.00	$4,290.00	$4,719.00	$12,909.00	
Staff subtotal:	$35,100.00	$38,610.00	$42,471.00	$116,181.00
EQUIPMENT				
2 computers/peripherals	$4,000.00	$0.00	$0.00	$4,000.00
1 office typewriter	$500.00	$0.00	$0.00	$500.00
Office furniture	$2,000.00	$200.00	$200.00	$2,400.00
Office supplies	$500.00	$550.00	$605.00	$1,655.00
Utility shelving	$200.00	$0.00	$0.00	$200.00
Open-reel tape	$2,875.00	$200.00	$220.00	$3,295.00
Cassette tape $1,200.00	$100.00	$110.00	$1,410.00	
Room air conditioner	$500.00	$0.00	$0.00	$500.00
2 open-reel tape players	$1,500.00	$0.00	$0.00	$1,500.00
1 studio cassette player	$300.00	$0.00	$0.00	$300.00
Tape editing station	$200.00	$0.00	$0.00	$200.00
Equipment subtotal:	$11,775.00	$1,050.00	$1,135.00	$13,960.00
OFFICE RENTAL*				
Office space $0.00	$0.00	$0.00	$0.00	
Tape storage room	$0.00	$0.00	$0.00	$0.00
Office rental subtotal:	$0.00	$0.00	$0.00	$0.00
OTHER COSTS				
Airtime	$10,000.00	$10,100.00	$10,201.00	$30,301.00
Tape copying service	$250.00	$275.00	$302.50	$827.50
Misc. tape maintenance	$150.00	$165.00	$181.50	$496.50
Computer maintenance	$500.00	$550.00	$605.00	$1,655.00
Local transportation	$300.00	$330.00	$363.00	$993.00
Mailing $200.00	$220.00	$242.00	$662.00	
Telephone, utilities*	$0.00	$0.00	$0.00	$0.00
Contingency $800.00	$880.00	$968.00	$2,648.00	
Other costs subtotal:	$12,200.00	$12,520.00	$12,863.00	$37,583.00
YEARLY SUBTOTALS, GRAND TOT:	$59,075.00	$52,180.00	$56,469.00	$167,724.00

* Provided by MOE

Option 4:

Continuation of La Familia de los Números and Provision of a Small-scale Instructional and Informational Radio service to the MOE

Staff:

8 professionals
1 secretary

Total staff: 9

Recommended professionals:
Marizela Turcios
Mario Ramírez
Gloria Camero
Conni Rosales
Carlos Zelaya
Zoila Zelaya
Sagrario Gonzales
Delia Sosa

Equipment:

6 XT-class or better personal computers, each w/20 mb hard disk, monitor, 24-pn dot-matrix printer, software
2 office typewriters
1 4'x 8' locking cabinet
Approximately 18' x 16' open metal utility shelving
Office furniture
Office supplies
1,650 30-minute open-reel studio tapes
1,000 30-minute cassette tapes
Two 2-track 1/4" open-reel studio tape playback units with full-fidelity speakers
1 2-chamber studio cassette player with high-speed dub function
1 Tape splicing block

Office space:

A two-room office for 8 professional staff, located in downtown Tegucigalpa near GM Studios.
Secure, air-conditioned tape-storage room with work area for Production Staff Member.

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Studio recording facility:

A permanent contractual arrangement with GM studios for dependable access as needed to GM studios and technicians.

Other costs:

Airtime
Studio time
Tape copying service
Replacement tape
Miscellaneous tape editing and maintenance supplies
Local transportation
Mail and communication

Discussion:

This is a very strong option. Option 4 is the best option if, as seems likely, immediate full implementation of the Radio Spanish series and preservation of the radio activity staff and equipment intact as it now stands, cannot be achieved.

The following services can be provided under Option 4:

1. Continuation of the Familia de los Números series.
2. Development of small-scale school radio and public informational and educational radio services for the MOE.
3. Development of a reduced version of Radio Español (though not the full series as originally contemplated).

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RLP/H RECOMMENDATIONS FOR SUSTAINING INTERACTIVE RADIO SERVICES
OPTION 4: ILLUSTRATIVE BUDGET

	1991	1992	1993	SUBTOTALS:
STAFF				
8 Professionals	$46,800.00	$51,480.00	$56,628.00	$154,908.00
1 Secretary	$3,900.00	$4,290.00	$4,719.00	$12,909.00
1 Messenger	$1,040.00	$1,144.00	$1,258.40	$3,442.40
Staff subtotal:	$51,740.00	$55,770.00	$61,347.00	$168,857.00
EQUIPMENT				
6 computers/peripherals	$12,000.00	$0.00	$0.00	$12,000.00
1 office typewriter	$450.00	$0.00	$0.00	$450.00
Office furniture	$3,000.00	$200.00	$200.00	$3,400.00
Office supplies	$800.00	$880.00	$968.00	$2,648.00
Utility shelving	$350.00	$0.00	$0.00	$350.00
Open-reel tape	$3,500.00	$500.00	$550.00	$4,550.00
Cassette tape	$1,700.00	$250.00	$275.00	$2,225.00
Room air conditioner	$400.00	$0.00	$0.00	$400.00
2 open-reel tape players	$1,200.00	$0.00	$0.00	$1,200.00
1 studio cassette player	$275.00	$0.00	$0.00	$275.00
Tape editing station	$75.00	$0.00	$0.00	$75.00
Equipment subtotal:	$23,750.00	$1,830.00	$1,993.00	$27,573.00
OFFICE RENTAL				
Office	$750.00	$825.00	$907.50	$2,482.50
Telephone, utilities	$400.00	$440.00	$484.00	$1,324.00
Office rental subtotal:	$1,150.00	$1,265.00	$1,391.50	$3,806.50
STUDIO FACILITY CONTRACT	$6,000.00	$6,600.00	$7,260.00	$19,860.00
OTHER COSTS				
Airtime	$10,000.00	$10,100.00	$10,201.00	$30,301.00
Computer maintenance	$500.00	$550.00	$605.00	1,655.00
Local transportation	$300.00	$330.00	$363.00	$993.00
Mailing	$200.00	$220.00	$242.00	$662.00
Contingency	$1,000.00	$1,100.00	$1,210.00	$3,310.00
Other costs subtotal:	$12,000.00	$12,300.00	$12,621.00	$36,921.00
YEARLY SUBTOTALS, GRAND TOT:	$94,640.00	$77,765.00	$84,612.50	$257,017.50

Option 5:
Continuation of La Familia de los Números and Full Development of Radio Español

Option 6:
Institutionalization of Full Existing Broadcast, Production, and Service Capacity

Discussion:

These options are probably not realistic considerations in terms of continuing USAID involvement, and are therefore not detailed.

Recommendation

RLP/H recommends Option 4.

Considering both costs and potential benefits, Option 4 is a virtually complete preservation of the USAID/Honduras investment in school radio. Option 4 implies implementation of the interactive radio as an instructional-technology service in Honduras, of limited scope but of real value.

It completes the removal of the radio activity from AVANCE with the activity virtually intact.

Finally, it implies institutionalization of the activity. Under Option 4, full institutionalization along lines suggested in Section IV above, with independent fundraising and income-generating capacity, and with strong permanent ties to public education, can be achieved. It is expected that these capacities can be achieved with relative ease over three years by the staff named above.

It is recommended that USAID provide sustaining funding, in available local currency or otherwise, over three years, totaling U.S. $257,000, as shown in the Option 4 illustrative budget.

APPENDIX 1:
SUMMARY LIST OF DOCUMENTS PREPARED UNDER THE HONDURAS RADIO LEARNING PROJECT

I. GENERAL PROJECT DOCUMENTS

A. Major Reports

"Honduras Radio Learning Project: Annual Report for 1989," David Edgerton, 2/90.

Honduras Radio Learning Project Quarterly Reports, David Edgerton, 10/87-8/90.

"Honduras Radio Learning Project: Recommendations for Extension of Technical Assistance to AVANCE," David Edgerton, 10/89.

"Honduras Radio Learning Project: Special Interim Report on the Status of SEI," David Edgerton, 9/89.

"Honduras Radio Learning Project: Annual Report for 1988," David Edgerton, 2/89.

"The Honduras Radio Learning Project: Mid-point Review of Technical Assistance to AVANCE," David Edgerton, 11/88.

Honduras Tela Conference Report, 11/88.

"Honduras Radio Learning Project: 1988 Implementation Plan," David Edgerton, 2/88.

Honduras Radio Learning Project Monthly Logs, David Edgerton, 5/87-10/87.

Honduras Radio Learning Project Implementation Plan, David Edgerton, 4/87.

B. Trip and Other Consultant Reports

Trip Report, Short Summary of Activities at AVANCE's Impresiones Laser, Betsy Gleckler, 7/90.

"AVANCE: Computer Mini Course Series," Chris Friend, 4/90.

"Regional Radio Programming for Latin America," in March 1990 issue of the Radio Learning Newsletter, Dr. José Carleton Corrales.

"Alternative Power Sources Interim Project Report," Chris Friend, 11/89.

"Editorial AVANCE: Plan Gerencial," Kurt F. Muse en colaboración con Dr. Carleton Corrales, Katyna Argueta and Elizabeth Booth, 12/88.

"Honduras Field Accounting Systems Review," Bernard Fisker, 12/88.

Trip Report, AVANCE Business Development Plan, Carl Allen, 8/89.

"Social Marketing + Radio = Educational Success," Elizabeth Booth and Dr. José C.C. Calix, 1988.

"Plan Revisado de Desarrollo Empresarial de AVANCE," Carl Allen and Elizabeth Booth, 8/88.

Trip Report, Steven Kozlow, Formative Evaluation Specialist, 6/88.

"Project Begins in Honduras," in April 1988 issue of the Radio Learning Project Newsletter, David Edgerton.

"Plan para la Creación de la División de Publicaciones de AVANCE," Cristian Calderon, 4/88.

"AVANCE: Analysis Estuctura Organizativa Actual," J.T. Gloetzner, 10/87.

Trip Report, Julia M. Ledee, Radio Production Advisor for Sani Radio, 9/87.

Trip Report, Altagracia Diaz de De Jesus, Especialista en Gerencia de Proyectos Radio Interactivos, 7/87.

Trip Reports and Communiques from Chris Friend on Computer Installation and Training for AVANCE.

"Plan General para Evaluación Formativa."

II. SOCIAL MARKETING DIVISION

A. Major Reports

"Informe Final: Resultados de la Prueba del Producto 'La Familia de los Numeros' en Serie y Bay Islands English Project (BIREP) en Serie," Social Marketing Division, 12/88.

"Resultados Sobresalientes del Estudio de Mercado con Maestros del Primer Grado," Social Marketing Division.

"SEI Marketing and Communication Plan," Social Marketing Division, 1988.

"Results of the Qualitative Study for the Program of Educational Interactive Radio," Social Marketing Division, 1988.

"Educational Materials Audit (In Support of the Interactive Radio Division)," Social Marketing Division, 10/87.

Monthly Reports for AVANCE's Social Marketing Division, 7/87-10/87.

Discussions on Social Marketing Division, Elizabeth Booth, 1987.

A. Trip and Other Consultant Reports

"Estudio de Mercado: Resultados de las Entrevistas Grupales," Elizabeth Booth and Gary Heald with assistance from AVANCE's Social Marketing Division, 12/88.

"Market Analysis of Purchase and Usage Patterns of the Interactive Radio Instructonal Package: 'La Familia de los Números'," Gary Heald, 12/88.

"Determinants of Market Demand for Commercial Interactie Radio Products: An Elaboration of Expectancy-Value Theory," Gary R. Heald.

"The Effects and Expectations and Values on Honduran Teachers' Decisions to Purchase and Recommend Interactive Radio Learning Products," Gary R. Heald.

"Resultados de la Investigación Cualitiva para el Programa de Radio Interactiva Educacional," José Griera, Technical Assistant for the Social Marketing Division.

Trip Report, Dennis D. Embry, Educational Products Marketer, 8/87.

III. LA FAMILIA DE LOS NUMEROS

A. Major Reports

"Cost Study for 'La Familia de los Números'," Patricia Godoy, 9/90

"Diseño Instruccional: La Familia de los Números, Primer Grado," Jamesine Friend, 8/90.

"Diseño Instruccional: La Familia de los Números, Segundo Grado," Jamesine Friend, 8/90.

"Diseño Instruccional: La Familia de los Números, Tercer Grado," Jamesine Friend, 8/90.

"Grade 2 Summative Evaluation: Preliminary Results," Klaus Galda, 5/90.

Evaluation of La Familia de Los Números - First Grade, Jamesine Friend, 1989.

"Comments on First Grade Lessons," Jamesine Friend, 1988.

"Proposal for Mental Arithmetic Curriculum," Jamesine Friend, 11/87.

"Lists of Topics for Mental Arithmetic," Jamesine Friend, 8/87.

"Comments on 1985 Math Tests for Second and Fourth Grades," Jamesine Friend, 8/87.

B. Trip and Other Consultant Reports

Trip Report, Review of Data from Second Grade Pretests, Steven Kozlow, 5/90.

Trip Report, First Grade Revision, Jamesine Friend, 10/89.

Trip Report, First Grade Revision, Steven Kozlow, 10/89.

Trip Report, Second Grade Scriptwriting and Formative Evaluation, Jamesine Friend, 7/89.

Trip Report, Revision of First Grade Master Plan, Steven Kozlow, 7/89.

Trip Report, Assist Scriptwriters for Second Grade, Jamesine Friend, 4/89.

Trip Report, Master Plan for Second Grade Arithmetic, Jamesine Friend, 2/89.

Notes to Scriptwriters, Jamesine Friend, 2/89.

Trip Report, Evaluation of First and Second Grades Arithmetic, Jamesine Friend, 1/89.

Trip Report, Master Plans and Outlines for Arithmetic, Jamesine Friend, 3/88.

Trip Report, Master Plan, Jamesine Friend, 2/88.

IV. RADIO SPANISH

A. Major Reports

Design and Plans for Spanish Reading Course, Friend and Kozlow, 7/90.

"Sequence of Instruction in Syllable in Español 1, Series Mi Honduras," Jamesine Friend and Steven Kozlow, 4/90.

"Radio Spanish Implementation Plan," 1/90.

"Textbook Analysis for Radio Spanish," Jamesine Friend, 1/90.

Jamesine Friend and Steven Kozlow's Comments on Radio Spanish Readiness Manual, 1990.

"Computer Ananlysis of the Textbook Español 1, Jamesine Friend, 11/89.

"Preparatory Work for Development of Radio Reading Course, Jamesine Friend, 11/89.

Analysis of First Grade Reader, Jamesine Friend, 1/89.

B. Trip and Other Consultant Reports

Trip Report, Review of Data from Second Grade Pretests, Steven Kozlow, 5/90.

Trip Report, First Grade Revision, Jamesine Friend, 10/89.

Trip Report, First Grade Revision, Steven Kozlow, 10/89.

Trip Report, Second Grade Scriptwriting and Formative Evaluation, Jamesine Friend, 7/89.

Trip Report, Revision of First Grade Master Plan, Steven Kozlow, 7/89.

Trip Report, Assist Scriptwriters for Second Grade, Jamesine Friend, 4/89.

Trip Report, Master Plan for Second Grade Arithmetic, Jamesine Friend, 2/89.

Notes to Scriptwriters, Jamesine Friend, 2/89.

Trip Report, Evaluation of First and Second Grades Arithmetic, Jamesine Friend, 1/89.

Trip Report, Master Plans and Outlines for Arithmetic, Jamesine Friend, 3/88.

Trip Report, Master Plan, Jamesine Friend, 2/88.

IV. RADIO SPANISH

A. Major Reports

Design and Plans for Spanish Reading Course, Friend and Kozlow, 7/90.

"Sequence of Instruction in Syllable in Español 1, Series Mi Honduras," Jamesine Friend and Steven Kozlow, 4/90.

"Radio Spanish Implementation Plan," 1/90.

"Textbook Analysis for Radio Spanish," Jamesine Friend, 1/90.

Jamesine Friend and Steven Kozlow's Comments on Radio Spanish Readiness Manual, 1990.

"Computer Ananlysis of the Textbook Español 1, Jamesine Friend, 11/89.

"Preparatory Work for Development of Radio Reading Course, Jamesine Friend, 11/89.

Analysis of First Grade Reader, Jamesine Friend, 1/89.

V. EL AGRICULTOR

A. Major Reports

Quarterly Reports for El Agricultor, 2/89-7/89.

Estrategia de Mercadeo de El Agricultor, 6/89.

Management Plan for El Agricultor, 5/89.

B. Trip and Other Consultant Reports

Trip Report, "Ideas para la Programación y Diagramación de El Agricultor: Segundo Informe," Edward Trayes, 5/89.

Trip Report, "Ideas para la Programación y Diagramación de El Agricultor," Edward Trayes, 3/89.

"Informe sobre Asesoría Técnica," Francisco Vasquez, 2/89.

Trip Report, AVANCE/El Agricultor Consultancy, Nancy Torrey, 11/87.

VI. BAY ISLANDS RADIO ENGLISH PROJECT

A. Major Reports

"Bay Islands Radio English Project (BIREP): Feasibility Assessment," David Edgerton, Joan Ellering, Aida Grave de Peralta, and Terry Sprouse.

"Bay Islands Radio English Project (BIREP): Implementation Plan," David Edgerton.

B. Trip and Other Consultant Reports

Trip Report, Bay Islands English Project (BIREP), Philip A.S. Sedlak, 3/89.

Trip Report, Bay Islands English Project (BIREP), Philip A.S. Sedlak, 2/89.

VII. PROCUREMENT

Studio B Equipment Specifications List (Final Draft), Interlock Media Associates, 5/90.

Studio B Equipment Specifications List (Preliminary Draft), Interlock Media Associates, 10/89.

"How to Procure for AID-Funded Projects," Terry Collier, 9/88.

"AVANCE Procurement Guidelines," David Wood, 10/87.

Documents on Computer Needs and Procurement Procedures for AVANCE, Bruce Newman and David Edgerton, 1987.

APPENDIX 2
SUMMARY LIST OF RLP/H SHORT-TERM TECHNICAL ASSISTANCE

1987 CONSULTANTS:

Altagracia Díaz de De Jesús, Interactive Radio Specialist (12 days, Jul. 1987): Orient AVANCE staff to technical aspects of interactive radio instruction. Analyze previous planning. Discuss steps to follow and strategy for best results in cycle of scriptwriting, production, and evaluation.

John D. Miller, Radio Engineer (59 days, Jul. 1987-Feb. 1988): Assist AVANCE in reviewing competitive bids for radio production equipment. Install equipment in AVANCE studio, including coordination of site modification. Train AVANCE staff in use and maintenance of studio equipment.

Dennis Embry, Educational Products Marketer (5 days, August 1987): Assist AVANCE in designing an initial market research study, focusing primarily on interactive radio but including questions on other AVANCE educational products.

Julia Ledee, Radio Production Advisor (10 days, Aug. 1987): Provide orientation in general radio production techniques; train head of production in producing from a script; studio production/direction of interactive radio.

Georgina Rivas, Interactive Radio Scriptwriter - Math (7 days, Aug. 1987): Provide guidance to script-development team in scriptwriting, particularly in development of interactive radio math scripts. Assist in writing and review of scripts.

Bruce Newman, Computer Systems Specialist (7 days, Sept. 1987): Review computer needs of AVANCE. Prepare comprehensive plan for providing computer capability, including a description of the proposed system, a list of commodities, and a preliminary proposal for installation, maintenance, and use.

Jose Griera, Qualitative Market Researcher (32 days, Sept.-Oct. 1987): Assist AVANCE in design, implementation, analysis, and presentation of initial qualitative market research study.

David Wood, Commodities Procurement Specialist (14 days, Sept.-Oct. 1987): Advise AVANCE on design and development of an independent, internally administered commodities procurement system. Orient AVANCE staff to the use of the system.

Javier de la Cueva, Creative Marketing Consultant (16 days, Oct. 1987): Assist AVANCE in developing a marketing plan for interactive radio. Review creative strategy for other AVANCE educational products.

John Gloetzner, Business Development Advisor (8 days, Oct. 1987): Develop an emergency preliminary report for USAID/Honduras and AVANCE management and board of directors, reviewing the state of AVANCE administration, including: present administrative structure, need for administrative reform, and proposed new administrative systems.

Bruce Geisert (no scope of work on file).

1988 CONSULTANTS:

Margaret Hoban, English Language Specialist (5 days, Feb.-Apr. 1988): write test instrument to test entering first graders in the Bay Islands, Honduras, for English language comprehension and production of English language structures and vocabulary; provide detailed instructions for interviewers administering the test; analyze test results.

Eduardo Apodaka, Print Equipment Specialist (no fee days, July 1988): Coordinate AVANCE staff fact-finding visit to small print-services facilities in the U.S. Accompany AVANCE travelers as technical specialist in print operations.

Carl Allen, Small Business Consultant (15 days, Jul.-Aug. 1988): Assist AVANCE in defining a business plan including general goals, three-year financial projections, organization, a one-year implementation plan, and a business plan review process. Assist in presenting the plan to the AVANCE Board of Directors.

Terry Collier, Procurement Specialist (8 days, Aug.-Dec. 1988): Assist AVANCE in procurement of printing systems equipment, computers, radios, and video recording apparatus; assist in preparing the invitation for bidders (IFB) for this equipment; assist in assessing bids and responding to bidders; review and revise AVANCE procurement manual.

Bruce Newman, Computer Specialist (2 days, Sept. 1988): Assist AVANCE in review and finalizing of specifications prepared for procurement of a computer system.

Gary Heald, Usage Study Consultant (20 days, Sept.-Dec. 1988): design an interactive radio education user study to provide a profile of teachers who are current, lapsed, and non-users; document current market conditions and factors influencing use; establish a methodology and data base for evaluating usage over time. By means of an initial sample, questionnaire, and teachers' meetings/discussion groups, collect and analyze data on use/non-use patterns; and collect qualitative data that can help direct and improve future program activities. (Consultancy partially supported by central ST/ED funding.)

Jonathan Schwartz, Ricardo Wray, Radio Production Specialists (4 days each, Nov. 1988): plan and conduct two conference workshops on studio production; conduct needs assessment of studio production equipment, systems, and practices for Honduras Radio Learning Project studio; review scope of work for 48-day consultancy in production and training.

Maria Claudia de Valdenebro, Graphic Artist (2 days, Nov. 1988): prepare art layout and mechanicals for conference materials for Second Latin American Conference on Interactive Radio.

Frieda de Garcia, Ute Jokisch, Simultaneous Interpreters, Second Latin American Conference on Interactive Radio (6 days each, Nov. 1988): provide translation for formal conference sessions and conference workshops; accompany participants to informal activities; assist in recording conference sessions.

Patricia de Avila, Simultaneous Interpreter (3 days, Nov. 1988): provide interpretation for World Bank/Malawi delegate during post-conference visit to RLP/Honduras office and studio; translate limited documentation. (Consultant supported by Radio Learning Project.)

Cristián Calderón, Small Business Development Advisor - Newspaper Publishing (8 days, Nov.-Dec. 1988): review the history and financial status of El Agricultor newspaper; develop a workplan for the re-launch of the newspaper designed to make the newspaper self-sufficient by the end of 1989, including: product re-structuring and editorial policy; pricing strategy; distribution systems; publicity sales strategy; promotional strategy; and financial projections.

Kurt Muse, Small Business Development Advisor in Publishing and Print Operations Management (12 days, Nov.-Dec. 1988): assist AVANCE in starting technical, management, and editorial operations for its new division, AVANCE Publications (Sp. translation Editorial AVANCE). Develop a business plan for startup of the operation, including: operating procedures, price setting policies, marketing strategies, coordination of materials production, delivery systems, collections, and a personnel plan. Establish a timeline and budget outline.

Aida Grave de Peralta de Bueso, "Computer Systems Coordinator" (25%-time position, Nov. 1988-Sept. 1990): supervise use and maintenance of AVANCE computer equipment; coordinate staff training in use of computers; supervise a systems assistant (position made possible by reduction of time allocated to clerical duties and AVANCE personnel providing clerical services).

Jonathan Schwartz (33 days), Ricardo Wray (30 days), Audio Recording Specialists (Dec. 1988-April 1989): train AVANCE studio staff; coordinate development of a management system and organizational routines for the efficient, effective use of AVANCE's studio recording equipment and supplies, and for deployment of AVANCE studio staff, designed to address AVANCE's present and future studio production needs. Three visits by consultants focused on (1) initial assessment; (2) equipment needs, music production for new English language series, and personnel search; and (3) staff training and establishment of controls for studio equipment and supplies.

1989 CONSULTANTS:

Philip Sedlak, Evaluation Specialist (33 days, Jan.-Feb. 1989): develop summative evaluation instrument to compare English language proficiency of non-participants with participants in Bay Islands Radio English Project pilot at end of first grade, and to compare English language proficiency at beginning and end of the three primary grades among participants. Organize test administration structure including recruitment and training of personnel.

Manolita Wetherell, Studio Engineer (13 days, Jan. 1989): assist AVANCE in dissembling the radio studio, moving of equipment and reinstallation of studio equipment in new location.

Francisco Vasquez, Small Business Development Advisor in Newspaper Publishing (6 days, Feb. 1989): review status of operations in publication of AVANCE newspaper El Agricultor; work with staff to complete newspaper marketing plan and plan for re-launching the newspaper; train staff in publicity sales.

Fortín Lagos y Asociados, "Pagemaker" Computer Management Specialists (Feb, 1989): Assist "El Agricultor" staff in relocation of computer equipment to San Pedro Sula; provide training in use of "Pagemaker" software; advise on maintenance of computer equipment.

Philip Sedlak, Evaluation Specialist (15 days, Feb.-Mar. 1989): assist AVANCE/SEI evaluation team in recording, printing, and administration of first-grade post-test of English language proficiency under Bay Islands Radio English Project pilot.

Maria Teresa Fiallos, Assistant Field-site Testing Coordinator (10 days, Feb.-Mar. 1989): participate with AVANCE/SEI Evaluation Director and evaluation team in test administration as part of the Bay Islands Radio English Project summative evaluation, including: scheduling test site visits; supervision and training of test administrators; general coordination.

Michael Blackmer, Audio Equipment Specialist (12 days, February to April 1989): tasks related to procurement and installation of a second educational-radio production facility in AVANCE/SEI offices in Tegucigalpa, including: technical evaluation of bids for procurement of equipment for studio facility; architectural plans for installation of the facility, and coordination of its installation.

Gabriela Isabel Galvez Montes, Advisor in Radio Production Techniques and Control-room Management and Operation (20 days, February to August 1989): analyze systems and procedures and assess production capabilities of studio equipment; provide operational, systems, and maintenance training to audio production staff of AVANCE/SEI; serve as co-producer as necessary.

Ed Trayes, Graphic Design Specialist (10 days, Mar.-Sept. 1989): initial visit to review graphic design of AVANCE El Agricultor newspaper; provide training in graphic design techniques; assist staff in selection of new personnel. Return visit to review and critique new elements introduced in graphic design of the newspaper; provide training in photographic concepts, production planning, marketing and distribution.

William Kostrewski, Business Advisor/Specialist in Financial Planning and Projections (15 days, May to June 1989): in conjunction with the Small Business Planning Development Advisor, provide advisory services to AVANCE in the rewriting of its business plan, addressing AVANCE's present administrative, financial, and technical profile and specific goals and objectives. Develop financial projections over a three-year period; present findings to AVANCE board and USAID.

Roman Valladares, Small Business Planning and Development Advisor (7 1/2 days, Jun-Jul 1989): work with AVANCE General Manager and with short-term Specialist in Financial Planning and Projections to prepare updated AVANCE Business Development Plan, addressing AVANCE's administrative, financial, and technical profile and three-year financial projections. Consultancy includes a visit to USAID Office of Financial Review and AVANCE offices of El Agricultor newspaper staff.

William Chong, Assistant Small Business Planning and Development Advisor (7 1/2 days, Jun.-Aug. 1989). Consultant to join business development/financial projections team to review AVANCE's administrative, financial, and technical profile and three-year projections.

Jonathan Schwartz (12 days), Michael Blackmer (11 days), Studio Design Specialists (Sept.-Oct. 1989): preliminary planning for design and installation of "Studio B," AVANCE's second audio production studio. Consultancy includes 2-5 days in Honduras and 5-8 days in the United States.

George Homsy, Assistant to Studio Design Specialist (9 days, Oct. 1989): Assist in preparation of design specifications for AVANCE radio production studio, including pricing, formating, organizing and categorizing equipment lists and facilitating communications.

Loren Finnell, The Resource Foundation (Oct. 1989-Sept. 1990): provide technical assistance to AVANCE in development of fundraising capacity, by means of annual membership in TRF and access to TRF materials, services, and personnel.

1990 CONSULTANTS:

-- (consultant not selected), Advisor in Beginning Reading Instruction (60 days, January to September 1990): work as member of AVANCE committee to advise in development of a beginning reading curriculum in Spanish for a radio reading course, including instructional design, theory and practice, methodological approaches, content, scope and sequence (assignment canceled based on revised technical assistance plan).

Jonathan Schwartz, Radio Studio Design and Production Specialist (12 days, Feb.-Apr. 1990): provide technical assistance in the procurement of a new multi-track audio production facility for AVANCE/SEI, serving as coordinator of technical review panel, addressing technical review questions, supervising draft of bid documents (U.S.-based consultancy).

Michael Blackmer, Audio Equipment Specialist (12 days, Feb.-Apr. 1990): provide technical assistance in the procurement of a new multi-track audio production facility for AVANCE/SEI, serving as principal technical specialist (U.S.-based consultancy).

Eric Grunebaum, Assistant to Radio Design and Production Specialist (6 days, Apr.-May, 1990): Assist in drafting bid documents and in technical review of bids for equipment for AVANCE radio production studio (U.S.-based consultancy).

Jonathan Schwartz (48 days, April to September 1990), and Michael Blackmer (24 days, Apr.-Sept. 1990); Studio Production and Systems Specialists: technical assistance in the design, installation of equipment, and staff training of a new multi-track audio production facility for AVANCE/SEI (assignments canceled based on revised technical assistance plan).

Betsy Gleckler, Desk-top Publishing Software and Systems Trainer (3 days, Apr.-Sept. 1990): provide periodic consultancy, training, and general troubleshooting as requested in the operation and creative use of the Impresiones Laser PageMaker DTP system and related systems and equipment.

LESOTHO RADIO LANGUAGE ARTS PROGRAM

by
Maurice Imhoof and Thomas D. Tilson

I. Setting, Series Design, and Implementation

1. Educational Challenge

The Kingdom of Lesotho is one of the smallest countries in Africa. Its 1.6 million people (the population's annual growth rate is 2.3%) inhabit a mountainous territory entirely above 5,000 feet in elevation, where only 13% of the land is suitable for cultivation. The country possesses few natural resources. About 60% of adult males between the ages of 20 and 44 work in the mines of South Africa. They generate over 50% of Lesotho's total GNP. During the last decade, agricultural yields have declined by an average of 3% per year because of soil erosion, the absent male labor force, and poor farming practices. Although Lesotho's terrain is well-suited to animal husbandry, the country suffers from declining animal quality and inadequate disease control.

The economic situation demands an effective educational system capable of preparing citizens for greater self-reliance, yet here, too, the nation confronts major challenges. Formal education is undertaken by a partnership of the government, the churches, and the community. It consists of a seven-year cycle of primary education followed by three years of junior-secondary schooling and two years of high school. There is one university in the kingdom.

Enrollment in primary schools in 1980 was 546,828. The number of primary teachers was 6,276, 19% of whom were unqualified. Although these statistics produce a pupil-teacher ratio of 56:1, the tendency to concentrate teachers in upper-primary classes in fact leads to more severe overcrowding at the lower-primary level. Lesotho has unacceptably high dropout and repeater rates; they result in an efficiency ratio of 2.11 at the primary level. That is, for every successful graduate of the seven-year primary program, the government has paid for 14.78 years of schooling, a terrible waste of scarce resources. To further complicate the situation, the highly academic curriculum has focused on preparing children for further schooling rather than on preparing them to contribute to community and national development.

The Basic and Non-Formal Education Systems (BANFES) Project was designed to meet such challenges. With funding from the Agency for International Development, a six-member consortium led by the Academy for Educational Development began in 1985 helping the Ministry of Education improve its capacity to provide efficient and effective education relevant to Lesotho's development needs. One focus of these efforts was strengthening

the curriculum through work at the National Curriculum Development Centre (NCDC) and the Instructional Materials Resource Centre (IMRC).

Command of English-language skills is crucial to Lesotho's national curriculum and to individual success at school and in work. After the first four years of primary education, English becomes the language of instruction; it is also, of course, the language of academic testing; and it is essential to commerce in the region. Nevertheless, many Basotho educators believe that standards of English in school have been declining for several years.

2. Selecting Radio as an Intervention

Soon after BANFES began, the English Division at the NCDC, recognizing that a significant number of Lesotho's primary-school teachers are underqualified for teaching English as a second language, asked for assistance in investigating the suitability of IRI for supporting English-language instruction in Standards (Grades) 1 to 3. Neither the Division nor the Project was interested in an effort to validate IRI as a method. The model had already proved successful in several subject areas including English as a second language, and in many countries. In the early 1980s, the Radio Language Arts Project in Kenya had demonstrated that IRI provided an effective vehicle for instruction in English as a second language. The issue facing the NCDC, therefore, was <u>adaptation</u>. Could <u>English in Action</u>, the IRI series developed for Kenya, be used effectively in Lesotho too?

Given fierce budgetary and personnel constraints, conventional solutions -- like an intensive, national teacher-upgrading scheme -- were impossible. Furthermore, the problem of poor achievement in English language skills was urgent: it contributed substantially to low efficiency and low effectiveness in the education system. The NCDC needed a remedy that promised immediate impact. With its demonstrated ability to raise achievement levels quickly and its low cost per pupil, IRI offered an appealing choice.

To investigate the potential of interactive radio instruction, the Primary English Panel arranged a small-scale pilot test in February, 1986. Lessons 1 - 20 of the Standard One radio series from Kenya were modified slightly and re-recorded at the IMRC on cassette tapes that simulated actual radio broadcasts. Five schools were selected as test sites, and a one-day training session was arranged for cooperating Standard One teachers. To observe and evaluate the lessons, panel members and curriculum specialists used the rigorous system of formative evaluation developed in Kenya.

After reviewing the pilot-test results, the panel decided, unanimously and enthusiastically, that IRI could be successful in

Lesotho. Members identified several areas where changes might be made (for example, to the length of pauses and the type of radio equipment). Then they decided to work towards offering English in Action to every school in the country on a voluntary basis; this would make Lesotho one of the first examples of national implementation of interactive radio.

Again the NCDC approached BANFES for assistance. BANFES offered the following resources: technical assistance was to be provided by specialists already on staff (in addition to their other responsibilities); a part-time administrative assistant was hired; and a consultant was engaged to work with a member of the panel on rewriting the scripts. USAID agreed to purchase radios to be sold to schools on a heavily subsidized basis (approximately $24 for a radio-cassette unit costing $80).

3. Adaptation

From 1979 to 1985 the Kenya Radio Language Arts Project adapted interactive radio to teaching English as a second language to lower-primary pupils. The series English in Action comprises one 30-minute radio lesson for each school day over a period of three years, with some lessons repeated before and after major school holidays. In all, 525 lessons designed for Kenya were adapted for use in Lesotho schools.

The process of adaptation was surprisingly simple. The role of English as a medium of instruction is the same in Kenya as it is in Lesotho, and English language syllabi for the lower primary standards are almost identical. Structurally and in terms of vocabulary, the two national curricula coincided. At first the lessons focused on school, family, and home. Then scriptwriters widened the focus of the lessons to include the community and the nation.

The work of lesson and script adaptation was carried out in the English Division, NCDC. Lessons were recorded at IMRC, also a division of the Ministry of Education. Adaptation was a three-step process: analysis and fit of the syllabi; analysis and fit of the cultural content; rerecording of the lessons.

First, a primary teacher and a technical advisor, in frequent consultation with the entire English Division, checked the fit of the two syllabi. Since Kenya and Lesotho both specify vocabulary and structures taught at each standard level, the task was uncomplicated. Approximately 40-50 vocabulary words from the Lesotho syllabus were incorporated into the radio lessons at each standard level. An equivalent number of vocabulary items from Kenya, many of them particular to the national setting, was dropped.

At the next step, each lesson was read carefully and modified appropriately for linguistic and cultural differences. In the earlier lessons, differences were reflected at the

vocabulary level (different animals and foods). In the more advanced lessons, the changes often required replacement of whole situations or narratives to reflect environmental or cultural differences (going to the coast in Kenya and going to the mountains in Lesotho). It is important to emphasize, however, that these changes did not affect the teaching of a specific linguistic skill (understanding past tense; reading a narrative; forming questions) but only the cultural settings for those skills. As students' command of English grew, of course, adaptation of the lessons became more complicated and took more time.

The third step in the adaptation process was recording the revised lessons. Local actors, Sesotho-speaking but with the best English skills available, recorded the lessons. A local musician provided the music. A technical advisor monitored the studio production on a part-time basis.

The adaptation process assured that the radio lesson content was congruent with and supported the objectives and content of the regular English language program; it guaranteed that the interactive radio methodology supported the need of teachers for a better way to teach beginning aural-oral second-language skills; and it established clear ownership of the lessons by the English Division, placing them within the normal curriculum development and approval process at NCDC.

4. Pupil Achievement

Evidence from instructional radio projects around the world confirms radio as a successful innovation in the primary classroom. (See Friend, Searle, Suppes, 1980; Imhoof and Christensen, 1986; Eshgh, Hoxeng, Casals, 1988; Edgerton, 1989; Fryer, 1989.) The Kenya Radio Language Arts Project provided convincing data that pupils who received instruction by radio made greater gains in English language achievement than pupils taught by conventional methods. The radio group showed significant gains in all language skills (listening, speaking, reading, writing), with the most striking gains in listening. As reported by Spain and Oxford (1986), the differences in group means between radio and regular pupils consistently favored the radio group.

Calculation of effect size clearly demonstrates the superiority of radio instruction in Kenya. If an effect size of .20 is considered a clear success, the Kenya effect size of .47 overall puts interactive radio instruction at considerable advantage over conventional instruction. Interactive radio instruction produces such results almost immediately. Radio therefore has a significant advantage over other interventions (like teacher training) that take much longer to implement and are much slower to demonstrate positive results.

Data from the Kenya pilot program convinced Lesotho to

implement the program on a national scale and suggested that extensive testing of pupils was unnecessary. Two types of evaluation were planned, however. The first was a modification of the pupil achievement testing carried out in the Kenya project. It was assumed, incorrectly as it turned out, that the lapped-year testing design could be reduced to testing one standard only and that test items of vocabulary could be modified without revalidating the entire test. These false assumptions, coupled with test administration problems, the project time-frame, and a prolonged teachers' strike, resulted in the abandonment of pupil achievement testing.

The second component of the evaluation was an assessment of teacher use of and attitudes toward the lessons and the methodology. Although problems arose with implementation of that assessment, 90 percent of teachers interviewed expressed their desire to continue using the radio English lessons (Harpring, 1990). The difficulties raised by teachers in this study centered on logistics: delivery of print support materials, radio maintenance and replacement, availability of batteries, and teacher orientation or training.

5. Development and Implementation

Implementation of instructional radio for the first time and on a national scale is a complex and intense effort that must be well planned in advance. But it's impossible to anticipate all potential problems. Although it was expected, for example, that the first teacher orientation would be rushed and its logistics difficult and perhaps confused, it was not expected that rains and floods would prevent many trainers from attending the first national radio English workshop. This unanticipated problem resulted in spotty training of teachers in many parts of the country, and its effects were felt over the entire period of implementation. At the time of the Harpring study, only 57% of the teachers using the adapted lessons had received specialized training in teaching by radio.

Development and implementation efforts fall into four major areas: adaptation of the lessons; printing and distribution of support materials; teacher orientation; and broadcast and follow-up. The areas of effort were anticipated, but the level of effort required was underestimated. Throughout the implementation phase, the level of effort was upgraded again and again, as personnel hours committed to the project increased more or less continuously.

Adaptation of the print support materials for teachers (in the form of teachers' notes on each of the daily lessons) and for children (in the form of worksheets), necessarily followed the adaptation of the lesson scripts themselves. Printing deadlines were not met in one instance, but the major hurdle was distribution of the materials to remote and mountainous regions. Several methods of distribution were tried before an effective --

but costly in the short term -- system of delivery to numerous regional centers was established. Communication with headteachers and teachers to inform them about the availability of materials in their regions was also difficult. Messages on Radio Lesotho proved most successful.

Appropriate mechanisms are now in place to support the instructional strategy. But problems with the national infrastructure remain. It is still difficult for some teachers to pick up materials at their regional centers, to get their radios repaired, to receive communication.

6. Sustainability

The radio lessons have strong support from teachers. Parents have also indicated their support through school committees. Ministry of Education officials have been convinced that the radio lessons are having a desirable effect on the quality of teaching and perhaps the standards of English. Therefore, a number of steps have been taken to assure sustainability. The complexity of effort and the degree of inter-institutional cooperation necessary for success may seem high, but collaboration is already high and the institutional infrastructure exists. Three dimensions affecting sustainability deserve comment: political, administrative, and technical.

Political

By the end of the 1990 school year, all three standards were receiving radio English instruction, interrupted by a teachers' strike in some schools. Given the degree of ownership established by institutions such as NCDC, instructional radio has not been politicized.

Administrative

Institutions within two ministries must cooperate in order for the radio lessons to continue in Lesotho. Radio Lesotho, under the Ministry of Information and Broadcasting, broadcasts the lessons and is committed to their continuance; it also provides air time for other information and education programs and has begun the process of developing a new education channel for increased programming.

IMRC, under the Ministry of Education, houses the tape library of the radio lessons, provides Radio Lesotho with the correct tapes for one week's broadcasts at a time, and monitors the quality of the tapes and broadcasts. Normally, IMRC develops information and education programs for the Ministry of Education. Archiving the tapes and monitoring the lessons will be an additional burden, but it is one that fits within the duties of the audio-visual section of IMRC. A repair scheme for school radios, to be administered by IMRC, will be an additional activity.

The English Division, NCDC, provides inservice training to teachers using radio lessons, monitors the programs in the schools, and supervises the sale of radios to eligible schools. In addition it will coordinate and supervise the replenishment of print support materials in collaboration with the School Supply Unit, Ministry of Education. These activities are not unlike the regular curriculum development and implementation tasks carried out by the division. They will require part-time attention of a staff member in addition to other duties.

The School Supply Unit normally distributes textbooks and other materials to schools throughout the country. School fees are collected and placed in an SSU account until such time as new texts and materials are purchased commercially and then distributed. The SSU, in collaboration with the English Division, will arrange for the replenishment of the radio support materials in much the same manner that textbooks are replaced in the school system.

Sustaining the Lesotho Radio Language Arts Program will require additional, but modest, administrative effort within the existing administrative infrastructure.

Technical

Technical issues are not of great concern, although some of the capacity is not yet in place. Radio Lesotho's technical capabilities are growing. Reception is improving with the implementation of regional transmitters. The creation of an additional broadcast channel will result in better reception in some areas as well as expanded air time. Implementation of a proposed training program will enhance production and evaluation capabilities, leading perhaps to greater sophistication in use of the medium in education as well as entertainment.

Only minimal technical capabilities are necessary for IMRC to sustain the radio English broadcasts. The institution can sustain but not innovate. It would have difficulty in producing additional, high-quality educational programming due to insufficient and inadequate studio and editing facilities.

Can the institutions responsible for an interactive radio effort effectively sustain such a program in Lesotho? Experience with distance education and schools broadcasting in Africa seems to suggest that without innovation and growth, difficulties with sustainability surface quickly. People get bored, equipment deteriorates, scheduling becomes erratic, support materials are harder to replace, listenership declines. It may not be enough, therefore, to leave in place only those requirements for uncreative repetition of an established structure. Instead it may be necessary to challenge the system and the people who operate it to expand and alter interactive radio instruction so that it becomes an integral and critical factor across subject areas in Lesotho's schools.

II. Costs in Lesotho

1. Context

The costs for the English in Action series for grades 1-3 in Lesotho includes both development and incremental costs. The development[1] costs include the expenditures for adapting the radio series from the RLAP programs originally created in Kenya to the curriculum and culture of Lesotho. As described earlier, minor changes were made to the curriculum, the scripts were revised to reflect the culture in Lesotho, and all the lessons were rerecorded. The incremental costs are those expenses above and beyond the normal expenditures for schools that would be required to sustain the radio programs on a national basis for a long period of time. This section also presents the total annual costs of the series, that is, the sum of the development and incremental costs. In addition, the costs per student are presented. Finally, the allocation of the incremental costs to various groups (Ministry of Education, Ministry of Information and Broadcasting, parents, and teachers) is shown.

2. Development costs

The development costs for adapting the 525 lessons for grades 1-3 are presented in Table 2.1.

SUMMARY OF DEVELOPMENT COSTS	
Personnel	
Host Country	96,201
Technical Assistance	447,931
Furniture and Equipment	33,319
Operational Costs	98,023
Summative Evaluation	45,624
@ 0% Discount Rate	721,098
@ 7.5% Discount Rate	1,225,367

Table 2.1 Development Costs

The total expenditures were $721,098 (the amount in Table 2.1 showing a 0% discount rate. The discount rate, sometimes referred to as an opportunity cost, reflects the amount of income or benefit that might have accrued if the money was put to another use. For example, the money could have earned interest

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[1] Some studies separate startup costs from development costs. For this study, we have lumped all such costs under development costs. In Lesotho the major startup cost was the pilot project, but this activity actually developed (e.g. adapted) the first twenty lessons. The distinction between startup costs and development costs does not appear to be useful in this situation.

in a savings account. The discount rate is a value stated as an interest rate that reflects the cost of withdrawing resources now in order to produce greater consumption later. For this analysis, as for the cost studies in this chapter of Bolivia and Honduras, a 7.5% discount rate was used. The full development cost with a 7.5% discount rate was $1,225,367.

Approximately three-quarters of the host-country costs were for personnel who worked directly on production of the lessons -- actors (38% of the costs), producer (18%), musician (10%), and studio technician (8%). Outside technical assistance was the most expensive component, accounting for 62% of the total development cost. Of the total amount for technical assistance, 47% was devoted to script adaptation and 28% to studio supervision.

The summative evaluation accounted for only 6% of the total expenditures on development of the project. Of that 6%, outside technical assistance accounted for 34%; 25% was devoted to test administration, and 27% to test scoring. As mentioned earlier, the resources allocated to the summative evaluation were inadequate, as the adaptation of the test used in Kenya proved not to result in a good test for Lesotho.

Once the total development costs have been determined, it is necessary to average this amount over the useful life of the radio lessons. Assuming a 15-year life for the lessons, as is consistent with the cost studies of Bolivia and Honduras, the average annual development cost is $81,691, including a 7.5% discount rate.

3. Incremental Cost

The development costs are considered "sunk" in terms of making a decision about whether the lessons should continue to be used in the schools. The decision to continue the series depends on the incremental cost, or the additional expenditure required to sustain the radio lessons in the schools over a long period of time. The incremental cost is composed of both fixed and variable costs. These costs are explained on page 15.

The variable costs depend on the number of students. In Lesotho, the number of students in each grade is shown in Table 3.1.

The total incremental costs are shown in first column of data in Table 6.2.

Table I Student Enrollment

ENROLLMENT IN 1990	
Standard 1	80,481
Standard 2	63,420
Standard 3	56,972
Total	200,873

The total annual fixed and variable costs are shown in Table 3.2.

Table III Total Fixed and Variable Costs

TOTAL INCREMENTAL COSTS: STANDARDS 1-3	COST	PERCENT
FIXED COSTS		
Radio Transmission	41,490	87%
Administration	6,100	13%
Subtotal	47,590	
VARIABLE COSTS		
Radio Receivers	34,603	25%
Radio Maintenance	2,625	2%
Batteries	55,997	40%
Teachers Guides	4,943	4%
Student workbooks	39,127	28%
Teacher Training	1,481	1%
Delivery of materials	1,842	1%
Subtotal	140,618	
TOTAL INCREMENTAL COST	188,208	

The fixed costs account for 25% of the total incremental costs; most of this category of costs is devoted to transmission of the lessons. Of the variable costs, the replacement of batteries is the most significant component (40%); the student workbooks account for 28% (these are depreciated over three years) and the radios account for 25% (depreciated over five years).

Given the high cost of batteries, an estimate was made on how much this component might be reduced if Ni-cad rechargeable batteries were used and the recharging was provided by a solar panel. Such an arrangement would reduce the total battery cost by one-half, and the total incremental cost by 15%.

The incremental cost per student is $.94. This represents just 1.7% of the total expenditures per primary school pupil. The total cost per primary school student is $55., of which the Ministry of Education budget covers the remaining $24.

4. Allocation of Costs

Although the incremental cost per student is $0.94, the Ministry of Education does not pay this amount. The costs are allocated among the Ministry of Education, the Ministry of Information and Broadcasting, and the parents (with the teachers picking up some of the costs in some schools). The allocation of costs is shown in Table 4.1.

ENGLISH IN ACTION: STANDARDS 1 - 3

ALLOCATION OF COSTS

	Total Costs	Ministry of Education	Ministry of Information & Broadcasting	Parents &/or Teachers
Workbooks	$39,127	$39,127		
Teacher training	$1,481	$1,481		
Teacher's guides	$4,943	$4,943		
Radio receivers	$34,603	$24,847	$9,756	
Maintenance of radios	$2,115	$510		
Power, battery	$55,997		$55,997	
Radio transmission	$37,500		$37,500	
Duplication of worn tape	$3,990	$3,990		
Administrative & clerical	$3,600	$3,600		
Administrative overhead	$2,000	$2,000		
Administrative travel	$500	$500		
Delivery of materials	$1,842	$1,842		
Total Program Cost	$188,208	$84,445	$37,500	$66,263
Cost Per Student	$0.94	$0.42	$0.19	$0.33

200,873 students

Table 4.1 English in Action, Standards 1-3, Allocation of Costs

The Ministry of Information and Broadcasting finances Radio Lesotho, which broadcasts the English in Action series without charge. Although Table 4.1 shows that the cost to the Ministry of Information and Broadcasting for broadcasting time on Radio Lesotho is $84,445, in reality the budget of the Ministry will be little affected as the English in Action radio programs simply replace other programs.

The parents, perhaps with some participation by teachers, buy the radios (at a subsidized price) and the batteries; they also pay for the repair of the radios. On average, they provide $0.33 per student or a total of $66,263 per year.

The remaining expenditures must be covered by the Ministry of Education. On the average each year (in 1990 U.S. dollars), the Ministry must budget $.42 per student, or a total of $188,208, to the radio English lessons. This represents 1.79% of the budget for primary education. In the first years, the amount will be less than this as the radios, teacher's guides, and student workbooks are new and will not need to be replaced immediately.

5. Total Cost

The total cost of the radio series for each year is the sum of the development costs (with a 7.5% discount rate and averaged over fifteen years) plus the annual incremental cost.

Total Annual Cost = Annualized Development Cost + Annual Incremental Cost

The annualized development cost is $81,691. The total incremental cost for one year is $188,208, for a total annual cost of $269,899.

It is interesting to compare the costs in Lesotho, where an IRI series was adapted from another country, to the costs in Honduras, where a new series was developed. In Honduras, the incremental cost for sustaining the radio lessons is just 7.4% higher than in Lesotho, but the total costs were twice as high ($2.94), reflecting the considerable additional development costs for creating a new series.

SECTION 4

THE RADIO SCIENCE PILOT PROJECT IN PAPUA NEW GUINEA

1. Introduction

The Radio Science Project (RSP) is a new application of an existing technology in interactive radio instruction (IRI). It is funded by the A.I.D. Bureau for Science and Technology/Office of Education in Washington, D.C., and is a joint project between the Educational Development Center, Newton, Massachusetts, and the National Department of Education of Papua New Guinea. RSP's goal is to develop science lessons for grades four, five, and six for use in the Community (rural) Schools of Papua New Guinea. This is the first application of IRI to an open-ended, inquiry-based curriculum. It brings new challenges and requires new approaches to interactive radio design.

For sustainability within the educational infrastructure of a developing country, congruence must exist between the application of a technological intervention and the curricular goals of the national ministry or department of education. The intervention must offer substantial benefits over the existing pedagogy in cost, learner outcomes, and acceptance by teachers. It requires political support as well as technical support, and it must fit into the framework of educational change over time! The Radio Science Project sought to meet all of these conditions.

In developing the lessons, the RSP relied on interactive radio's model of formative evaluation. Techniques of production, format, testing, questioning, presentation, activity, and teacher training were continuously modified based on the results of formative evaluation. In addition, input from the National Department of Education, the National Broadcasting Commission, and other policy makers was solicited on a regular basis to ensure that the final product -- effective radio lessons in science -- would be acceptable and implementable throughout Papua New Guinea.

This section leads the reader through the significant activities and findings of the project as they developed. The final sections identify strategies for overcoming barriers to institutionalization.

3. The Radio Science Project Task

Encouraged by the success of several previous applications, the Education Development Center proposed a pilot study to determine if IRI could be applied to an open-ended curriculum like science. The pedagogical challenge was clear. Teachers in both developed and developing countries cite science instruction as among the most difficult to accomplish.

In Papua New Guinea, as in most developing countries, many

different circumstances exacerbate the problem of teaching science: financial resources are limited, rural areas are isolated, there is limited access to primary education, and teachers are scarce and poorly trained.

Universal primary education is a national goal, but teacher training institutions are hopelessly overburdened, and supplementary funds for upgrading teachers already in the schools, and for improving their materials and classrooms, are unavailable. In Papua New Guinea it is difficult to achieve an acceptable standard of instruction in any of the major areas of the curriculum for children in the primary grades. With science, the perceived difficulty of the content intensifies the problem.

Of all the technologies available to confront this challenge, the one of almost universal application is radio. Radio waves reach nearly everywhere in Papua New Guinea, even the remote and isolated highlands. There is an established schools broadcasting system that provides several hours of radio lessons per week to primary schools. Most schools have purchased radio receivers.

The Radio Science Project differs from earlier efforts in interactive radio instruction in two significant ways. First, the lessons are designed for children in the upper primary grades. The reason for this is simple. Although many teachers are quite comfortable with the science content found in the first few grades, they begin to experience difficulty as the content becomes more complicated. Since in developing countries like Papua New Guinea, teachers often have as few as ten years of formal education, their science background is seldom sufficiently strong to allow them to feel confident about teaching science, especially if they try to incorporate an inquiry approach and the use of even simple science equipment and materials. In addition, science instruction is typically given more time in the upper primary grades.

The second major difference between RSP and other interactive radio projects is that Radio Science incorporates inquiry-based teaching, open-ended questions, and the use of physical materials. This is the most basic challenge of the project. It is relatively simple to generate lively scripts that pose fact/recall questions. Curricular models in primary English and math include much nomenclature and structure, all of which lend themselves to interactions that are short and specific. Here's an example from beginning English:

TINA: Safina, is it dark now?
SAFINA: No, Tina. It isn't dark now.
It's dark at night.
RONO: Children, say, "It's dark at night."
(Pause 4)
RONO: It's dark at night. Again.
(Pause 3)
TINA: Yes....it's dark at night
(Imhoof and Christensen, 1986)

In a science curriculum for fourth, fifth and sixth grade students, however, instructional design must accommodate content or questions for which there is more than one logical answer. Given a concept like "Why is coffee grown in the Highlands?" or "When does the breeze blow toward the coast?," there is not just one right answer; nor are the various answers likely to be simple or straightforward.

With such specific challenges as these, the Radio Science Project and the National Department of Education began joint operations in 1986. Although the project was funded as a pilot study, its goal was a finished curriculum product, instructive and supportive to teachers as well as to students, that improved learning gains significantly and that could be implemented on a national basis at low cost.

During the first year in PNG, we secured facilities, began work on the research design of the project, and designed the radio curriculum for grade 4 based on the official national syllabus. Ten pilot schools in the National Capitol District and the Central Province were selected for testing the lessons and for formative feedback on student response and achievement and on teacher participation. During the 1988 school year sixty 30-minute fourth-grade lessons were designed and tested in the ten schools. There are two 30-minute lessons each week -- 20 minutes for the radio broadcast and 10 minutes for teacher-led activities.

In addition to broadcast tape, each lesson has a student worksheet and notes. A kit of simple materials was developed to be used with the lessons. Thirty schools in the East Sepik Province were selected for the summative evaluation and arrangements were made to broadcast the lessons on a biweekly basis on Radio East Sepik in 1989. The 60 lessons were broadcast and pre and post-achievement test was administered. At the same time, grade 5 materials were generated and tested in the schools chosen for formative evaluation. Because of severe budget restrictions in the government and schools, and the resulting difficulties for maintaining a science kit, the grade 5 lessons were designed to be used without a kit.

During 1990, Radio East Sepik broadcast the grade 5 lessons to the schools chosen for the summative testing. The project staff refined the grade 6 lessons, and prepared for

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institutionalization.

Materials and hands-on activities are still incorporated into the lesson, but the science educators found that over 90 % of the concepts could be supported by materials common in the schools or the communities. Most of these were also obtainable without cost. The list consists of bottles, cans, jars, string, wheels, plant material, food items, stones, et cetera. Further, it was found that judicious selection among activity types provided children with plenty to do while keeping cost at a minimum and teacher confidence high. For the few activities that required purchased materials (batteries, bulbs, mirrors, and the like), lessons were designed to be demonstrations.

The summative evaluation of the grade 4 materials resulted in a mean score for the experimental group of 46% overall, compared to 42% for the control group. The effect size is .36, which is quite impressive for a low cost intervention, with only two 20-minute radio programs per week. Using analysis of variance, we get a value of $F = 24.45$, which makes the difference of the means significant at the $p < .001$ level.

The test can be broken up into two parts: 13 questions on biological science and 17 questions on physical science. For both subject areas, the radio programs produced positive results, with the achievement gain being slightly larger for the physical science part of the test. The teachers have been particularly appreciative of the Radio Science Project's efforts to introduce physical science activities into the classroom. The largest gains were registered in the areas of light and electricity-magnetism, which are given more time in the Papua New Guinea grade 4 science curriculum than heat and sound. Of the 30 items on the test, the experimental group performed better on 22, while the control group did better than the experimental group on the remaining eight items.

Table 1
Test Results by Treatment

	Control		Experimental	
	% Correct	SD	% Correct	SD
Total Test (30 items)	* 41.5	14.0	46.5	15.1
Biology (13 items)	47.3	17.2	51.6	19.1
Physical Science (17 items)	37.0	15.4	42.5	15.5
Electricity-Magnetism (5 items)	39.5	21.7	50.1	21.5
Light (7 items)	45.2	22.6	52.3	22.9
Heat (3 items)	32.2	28.0	29.8	26.0
Sound (2 items)	18.0	27.8	13.8	23.9

* Effect size = .36
F = 24.45, difference of means between experimental and control group is significant at $p < .001$

Table 2 shows the test results for students by sex in both control and experimental schools. In both the control and the experimental group, the boys scored significantly higher than the girls on the science test. It is interesting to note, however, that in the experimental group the gender gap has lessened somewhat. In the control group, the difference between boys and girls is 6% percentage points, whereas in the experimental group it is only 4. In other words, although students of both sexes benefitted from the radio programs, the girls benefitted relatively more than the boys.

Table 2
Test Results by Student Age/Sex

	Control		Experimental	
	% Correct	SD	% Correct	SD
Sex				
Male	44.5	14.2	48.4	15.8
Female	38.4	13.1	44.4	14.2

The conclusions of the evaluation are the following:

1. The experimental group (science by radio) did better than the control group (traditional science teaching). Teaching science by radio is effective.

2. The gender gap was narrowed in the experimental group. The difference between boys and girls was higher in the control group than in the experimental group.

3. Programs were effective at all ranges of age. The highest scores were obtained by the 12 year old students. The experimental group's scores were higher than those of the control group at every age between 10 and 14.

4. Test instructions were understood by virtually all children. Both the experimental and control group had a small number of blank answers. Almost all children finished the test.

5. The radio programs were effective in both the biological and physical sciences, but slightly more effective in the physical sciences.

6. The experimental group scored better on 22 of 30 test items. These were spread across the whole curriculum.

7. The experimental group scored higher than the control group in all types of schools: government, Catholic, and Evangelical.

8. The radio programs were effective across a wide range of locales--remote rural, rural, and urban.

9. 21 of 27 schools in the experimental classes performed better than the control classes from the same school.

With every pilot project that develops new materials, the start-up costs are high. A.I.D. funded virtually all the development costs. Technical assistance decreased from a planned

four people to three once the project actually began work in PNG, to two after the first year, to one during the last year, and to no resident TA during the last several months. The distance of PNG from the United States, plus fairly high local costs, contributed to the high total costs. The resulting reduction in technical assistance required a scaling back of development and research activities. The development cost for the four-year project in PNG was approximately U.S. $3 million.

There are conditions in PNG's educational infrastructure that make RSP implementation on a national basis relatively expensive. (1) Radio as an educational medium has been in use in Papua New Guinea for twenty years and air time is available. (2) Each province has a Materials Officer to distribute materials, and the Curriculum Unit of the NDOE has existing warehouse and distribution facilities. The added cost for distribution of RSP student and teacher books involves shipping only. (3) Teacher training is done both locally and in the provinces by the Inservice College and staff, and travel budgets are in place.

An RSP inservice package was developed that included three days of training for Inspectors and "Trainers of Teachers." This cadre of RSP-trained inservice educators will be available to teach their colleagues in each of the Provinces how to use the Radio Science lessons. Teachers in PNG's Community Schools have one hour of released time each week for training, and this hour will be devoted to the Radio Science Project in the beginning of the 1991 school year.

The cost for the printing of student books (60 pages of drawings) is less than one Kina (US$.95). Since each book is designed to be shared by two students and to last five years, the cost of the book per student per year comes to less than ten toea (US$.10). The RSP Teacher's Notes, which consist of five pages of inservice directions and 120 pages of lesson notes, can be produced in the Curriculum Unit's print shop for K1.87 (US$1.97) each. These books are also expected to last five years. Allowing for teacher turnover, the cost of the Teacher's Notes is estimated at K.75 (US$.79) per teacher per year. Thus, the total per student cost for materials is approximately US.$12.

Although these are low costs for sustaining the radio science lessons, there is another striking advantage to implementation of RSP nationwide: it would cost less than the effort to bring the traditional science curriculum up to the standard envisioned for it when it was adopted twenty years ago. But it wasn't only because RSP is cost-effective that the Community Schools Board of Studies approved broadcast; it was because students measurably learned so much from the lessons that officials, administrators, and teachers echoed their enthusiasm. Saving money is an added benefit.

There were other unanticipated benefits. Because of the emphasis on Community School science and the effort to deliver

the curriculum in a different way, many teachers and curriculum officials became critical of the existing science curriculum. It is a third-hand modification (of two imported curriculum projects designed in the 1960s) that contains wonderful activities for children, but requires high scientific competence of teachers. Over the years, all of the higher level objectives have been removed from this curriculum, leaving only recognition and fact/recall objectives. The existing curriculum does not address the needs of youngsters who will be leaving formal schooling at the end of grade six, and who must be equipped to contribute to the development of their communities and their country. RSP focused attention on this problem. Now, through the efforts of leaders of the NDOE's Curriculum Unit, the Community Schools Board of Studies has begun to develop a new science curriculum for grades 1 through 6.

Additional attention was also brought to other radio programming for the Community Schools of Papua New Guinea. A comprehensive multidisciplinary broadcast committee established by the First Assistant Secretary of the NDOE has begun meeting to review programs currently serving the schools. Many broadcasts that were developed prior to independence will be replaced; many others will be revised and rerecorded. Most of these older programs are story-oriented and general. Typically, they present characters and situations specific to Papua New Guinea, but the voices are expatriate.

The contrast between these programs and the Radio Science broadcasts has given new and heated impetus to the use of indigenous national voices for radio characters and to the appointment of Papua New Guineans as scriptwriters. Two important requirements for the updated radio programs are that they closely support the teaching of the curriculum in the Community Schools and that they be interactive. These specifications are a direct result of the discussions that took place during the institutionalization phase of the Radio Science Project.

Another outcome of the political process of institutionalization is that national expertise was recognized. The project hired and trained over twenty national staff members. 50% of the staff of the Radio Science Project has been hired by the NDOE to continue the process of development of programs after institutionalization. Currently under consideration are instructional broadcasts in math, English, community life, and health.

3. Institutionalization

From the beginning, RSP staff planned to work through the political structure of the National Department of Education toward institutionalization. A broad-based advisory committee guided the effort. It was comprised of members of the NDOE and its Curriculum Development Unit, the National Broadcasting

Commission, teachers, administrators, university professors, evaluation specialists, and project staff. The committee established three subcommittees (evaluation, broadcast, and curriculum) that met throughout the life of the project. Their advice was invaluable.

Project staff also held regular meetings with key departmental staff members. Informational papers were generated and distributed continuously during the pilot phase, and an informational video made during 1989 was played on the national television station. The video was well received, as were the results of grade four evaluation. Several Committee members arranged screenings of the video at sites around the country. By now there was a sturdy base of support from teachers and provincial officials who had used the program, and there were key officials in the NDOE who were supportive. At this point the task was to win approval at the Community School Board of Studies.

We took three steps. First, to capitalize on the support from those using Radio Science in the field, we printed additional books (at a cost of US$7,500) to service 10,000 students in three provinces (our evaluation population had numbered only 1,000). A staff member traveled to four sites to provide inservice training for the additional teachers. To give an indication of the need teachers and administrators feel for help with science teaching, we had a far larger demand than we could satisfy, and our materials were exhausted within ten days. As the term progressed we asked teachers in these new sites to evaluate the program and requested that students write to us about Radio Science. That request brought us hundreds of letters of evaluation from teachers and students. We circulated those letters among officials at the NDOE.

Testimonials from those in the field proved eloquent. When the curriculum advisory committee of the NDOE met at the end of the 1989 school year, it mandated the addition of three more schools in the Capital District and the adjacent Central Province to the RSP trial. Project staff met with each committee member who had voiced concerns about institutionalization, transcribed those concerns, and responded to them in writing. The responses provided the basis for presentations at the RSP Committee meeting and at the Community School Board of Studies meeting.

The national staff of the Radio Science Project are intelligent and capable, and they are now empowered. Typically in Papua New Guinea, NDOE presentations have been made by expatriate members of the Curriculum Unit staff who are deeply involved in departmental decision making. Nationals hired for RSP, however, have gained confidence and expertise during the life of the project. They prepared, practiced, and delivered presentations about the Radio Science lessons, and Committee members listened to them.

Papua New Guineans take pride in their accomplishments and in those of their compatriots. During 1989 and 1990 the RSP showcased the expertise of its national staff. The point was made at each opportunity that the Project was the result of the work of Papua New Guincans. Each staff member had the opportunity to be heard in public at a meeting or on the radio.

Acceptance was overwhelming. The decision to institutionalize was unanimous. In an economy of severe need, Radio Science was given priority status. Not only is the Project institutionalized for the current curriculum, but the plan for a new science curriculum includes IRI as a basic component of instruction.

4. Educational Change

Many educational interventions that are both educationally and cost-effective have failed the test of sustainability in developing countries. Why didn't that happen with the Radio Science Project? There were doubts about long-term implementation at various points during the pilot phase. With production more than half complete, questions arose about whether the grade 6 materials should be developed or whether the time would be better spent on remaking the lessons for grades 4 and 5. In March, 1990, serious questions were raised about implementation of <u>any</u> of the lessons on a national scale. In addition, a shortfall in A.I.D. funds cut the budget by over 35%, and some A.I.D. officials were not sure that the project could be viable with the reduced level of funding.

But the A.I.D. Radio Science Project did continue and <u>has</u> been enthusiastically supported for institutionalization; the NDOE in Papua New Guinea has reorganized its structure to accommodate the project and to plan and implement additional IRI programming on its own. Crucial to institutionalization is that key NDOE administrators were part of the process from the beginning. Politics is a strong motivator among administrative decision makers. They must continually move forward, and they are likely to be biased toward the program that is current, or popular, or both -- in this case the Radio Science Project.

To highlight the currency and popularity of the Radio Science Project we printed additional books and provided inservice education for more teachers. Our trial teachers were enthusiastic but were few in number (45). When 300 teachers in three provinces and 4,000 students call for a program, it is difficult for administrators and officials to ignore their united voice. Expanding the base of teachers to a significant number and soliciting their candid response was the single most effective factor in gaining the wide acceptance that led to institutionalization.

The PNG project science educator has been hired as a curriculum officer within the Curriculum Unit of the NDOE and

assigned the task of administration of the Radio Science Project. With the support of the teachers using the program and the administrators and officials who have served on the RSP Committee, he will be able to sustain Radio Science in Papua New Guinea. Indeed, it is planned that IRI will be incorporated in several other curricular areas.

5. Postscript

The end of a project of this magnitude offers opportunities to speculate about the work so far. Interactive radio instruction has great potential for broader use as a teacher training medium. As we tried to improve Radio Science lessons, we taught teachers new skills through teachers' notes, through specific directions from radio teachers, and through a step process in which each lesson builds complex teaching techniques from the simple techniques presented in earlier lessons. We taught teachers vocabulary, how to set up activities, how to integrate science and other curricula, how to ask open-ended questions, how to use the processes of science, how to increase "wait time" while children answer questions, and how to feel comfortable in fielding questions to which they do not know the answers.

The question for which there is no empirical data is this: How well does this process of teaching the teachers work? All we have is anecdotal evidence. When we asked our cooperating teachers in Papua New Guinea the following question --"After listening to the radio broadcast, could you teach this lesson yourself?" -- the answer from most was a strong, unqualified "yes". Let's hope that, as educators, we are as good at listening to answers as we are at thinking up questions.

6. Conclusions

Cost-Effectiveness

Interactive radio instruction appears to be a highly cost-effective intervention for improving the quality of primary education. Three of the studies in this chapter report a significant positive impact on student achievement with effects sizes of .90 (mathematics in Bolivia), .49 (mental arithmetic in Honduras), and .39 (science in Papua New Guinea).

Studies in three of the countries also demonstrated that annual incremental costs per student are likely to be affordable in most countries: $.81 in Bolivia, $1.01 in Honduras and $.94 in Lesotho. In Honduras, this represents 1.0%, and in Lesotho 3.0%, of the ministry budget per primary school pupil. If one considers only the add-on cost of the IRI lessons that the ministry needs to pay, then the cost per pupil in Honduras is $.40 (or 0.4% of the Ministry budget) and $.42 per pupil in Lesotho (or 1.7% of the Ministry budget).

Two different types of cost-effectiveness studies are reported on, one in Bolivia and one in Honduras. The approach for each study was different. In Bolivia, Jamison measured the effect size association with a year of traditional instruction. He then established the efficiency measure by dividing the total gains by the total costs, with a resulting cost-effectiveness ratio is .19. In Honduras, the efficiency was measured by the ratio of the incremental benefits (in terms of effect size) to the incremental costs. The efficiency ratio is .49.

Sustainability

The four countries represent different approaches to development and implementation. In Honduras and Bolivia, the IRI programs were introduced through non-governmental agencies, one (AVANCE in Honduras) a private sector organization intended to generate income profitability, the other (Fe y Alegria in Bolivia) a Roman Catholic organization that runs 200 schools under contract to the government. In Papua New Guinea, the Radio Science Project was only an adjunct to the National Department of Education until the completion of pilot activities. In Lesotho, English in Action was from the beginning lodged in the National Curriculum Development Centre of the Ministry of Education.

Each institutional situation was, of course, a consequence of particular circumstances in the host country. Although long-term sustainability of the interactive radio series in Bolivia, Honduras, Lesotho, and Papua New Guinea cannot be assured, the prospects for sustained use in each country are promising. Those prospects depend on the following factors:

- the development of programs that are highly effective and valued by students and teachers alike
- efforts to keep costs low by limiting the need for supplementary materials and teacher training
- the involvement of important political constituencies, especially in national ministries or departments of education
- planning for the inclusion of recurrent costs in the national education budgets.

The relative strength of each factor varies from one country to another. Although the initial activities in a country can begin in many different ways, there should be a focus from the beginning on the needs for national implementation. In every country in which interactive radio has been present, long-term sustainability has required the support of the ministry of education. Interactive radio continues to demonstrate its power in the classroom, a pattern established with the Radio

Mathematics project in Nicaragua in the mid-1970s. But to have a major impact on education throughout the developing world, will necessitate a continuation of the more recent pattern of wide-scale implementation over many years.

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THE RADECO PROJECT

By: John Helwig

The Radio Assisted Community Basic Education Program (RADECO) was initiated in 1981 in the Dominican Republic as an alternative educational program for children without access to formal schooling. RADECO was designed to educate children in areas where there were no schools and no trained teachers. A series of 660 one hour radio broadcasts was developed by a team of skilled curriculum designers, script writers, radio production personnel and actors from 1981 to 1986. The one hour interactive radio programs included major segments covering reading and writing in Spanish and mathematics, and minor segments of subject matter on topics of science and social studies.

The RADECO project assisted communities to organize a "school" or covered area where 20 to 30 children could come together for the broadcast period every week day. A local facilitator was chosen to supervise the children, pass out worksheets and tune-in the radio. Originally 40 schools were organized, and today about 60 schools are operating in the Southwestern region of the Dominican Republic.

The RADECO project was financed with funds provided by the USAID Bureau of Science and Technology, Office of Education, in cooperation with the Dominican Secretariat of Education (SEEBAC). In 1986 the project was institutionalized by SEEBAC as the Department of Radio Education. SEEBAC has continued to broadcast the lessons and supervise the RADECO schools. A one-hour Saturday broadcast was developed and aimed at the community facilitators and parents of RADECO students.

The Department of Radio Education has also developed other educational broadcast programs directed to teachers and the general population. These programs cover such topics as infant and child care and civics.

In August of 1989 RADECO and the RLP sponsored a three day conference for 125 top-level educational officials. The conference urged the expansion of RADECO activities on several fronts. As a result of this conference, RADECO initiated, in October 1990, a project to utilize the math lessons to support the work of classroom teachers. The "RADECO math in the classroom" project was initiated in 50 classrooms in Santo Domingo and Barahona, and the lessons will be broadcast daily during the 1990-91 school year. The Department of Evaluation of SEEBAC will evaluate the lessons and a special commission will then determine the feasibility of continuing and expanding the use of RADECO math on a wide scale.

In early 1991 RADECO will initiate another project aimed at broadcasting the RADECO lesson package to learning centers that will be organized in the slums of Santo Domingo where there are no formal schools, or the formal schools are overcrowded or located at

a great distance. Several NGO's have already organized child care centers in slum areas. Under agreement with these NGO's,m the RADECO lessons will be used to educate children who otherwise would have no access to schools.

With support from the LearnTech project, RADECO is re-recording the RADECO lessons on new master tapes and re-making the offset plates for the student worksheets. LearnTech will provide approximately 10 person/weeks of technical assistance to RADECO in 1991 and 1992 to help with design and evaluation of the RADECO-in-the-slums and RADECO Math-in-the-schools projects and with general management and organizational issues. LearnTech will also provide funds for the purchase of paper and supplies, and for fuel and perdiem expenses related to the two projects.

expatriate members of the Curriculum Unit staff who are deeply involved in departmental decision making. Nationals hired for RSP, however, have gained confidence and expertise during the life of the project. They prepared, practiced, and delivered presentations about the Radio Science lessons, and Committee members listened to them.