

PDWAY 605

**PAPUA NEW GUINEA
RADIO SCIENCE PILOT PROJECT
EVALUATION**

**MICAEL OLSSON
EXTERNAL EVALUATOR**

**OFFICE OF EDUCATION
BUREAU FOR SCIENCE AND TECHNOLOGY
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT**

JUNE 1989

SUMMARY

SPONSORING OFFICE:

Office of Education
Bureau for Science and Technology
United States Agency for International Development
Washington, D.C., USA

PURPOSE OF ACTIVITY EVALUATED:

Research required for developing a radio-based instructional system for science at the primary school level in Papua New Guinea which, once developed, would be usable by other countries wishing to use radio to teach primary school science.

PURPOSE OF EVALUATION AND METHODOLOGY USED:

The purpose of the evaluation is to get an overview of progress towards institutionalisation and the achievement of learning gains among radio science pupils over pupils using the standard curriculum, keeping recurrent costs low and administration manageable for less developed countries like Papua New Guinea.

The methodology used included classroom and training observations, interviews and the examination of reports, materials, agreements, administrative forms and related documents. The interview technique avoided direct questions as much as possible, given the cultural demand to fulfill the expectation of guest inquirers. Rather, respondents were invited to discuss the strengths and weaknesses of prescribed topic areas.

FINDINGS AND CONCLUSIONS:

Neither the National Department of Education (NDOE) or the Radio Science Pilot Project (RSPP) staff feel that the radio science broadcasts could or should carry the burden of curriculum. Conversely both agree that the radio broadcasts are providing the kind of assistance, without which, the teacher cannot carry the burden of the curriculum either. The conclusion is that the RSPP has introduced a potentially effective co-teacher in the classroom and that learning gains are already beginning to emerge among science students in Papua New Guinea's community schools.

The project will need to facilitate the recruitment of a science educator sympathetic to the radio science approach within the NDOE if the RSPP is to be effectively institutionalised. And while the NDOE is interested in adopting the approach nationwide, there are still unanswered questions regarding add-on costs, the reach of radio and the need for more teacher-directed support materials.

RECOMMENDATIONS:

The RSPP should be extended by six months to June 1991 with the agreement that NDOE join the programme in 1991 to continue supporting the revision of materials, their implementation and the summative evaluation. Add-on costs should be calculated as soon as possible using the model as currently adapted

with revised kit materials and flip charts in lieu of worksheets in order to show that the two proposed Public Investment Programmes will cover the bulk of the add-on costs.

The RSPP should also develop a research model and initiate a survey to determine what percentage of rural community schools are likely to benefit from radio broadcasts. The study should aim to determine which areas get an adequate daytime signal, which areas get only a nighttime signal, which schools have radios, which schools require radio antennas and which areas have difficulty obtaining batteries.

Finally, along with workshop materials, more teacher-directed content should be camouflaged in the classroom broadcast tape, leaving one easy-to-read teacher-preparation guide and a one broadcast tape.

LESSONS LEARNED:

That science is different from maths and language instruction in that it does not easily lend itself to teacher-independent radio broadcast instruction. Broadcasts should be listen/interact events only, followed by hands on pupil activities that are teacher directed.

That the materials and distribution costs for RSPP materials currently being produced are high for less-developed countries like Papua New Guinea.

That more time is needed to design effective lessons that relate in practical ways to the life situation of the majority of the pupils and yet rely mostly on locally available materials.

PROJECT DETAILS

COUNTRY: Papua New Guinea

PROJECT TITLE: Radio Science Project

PROJECT NUMBER: #DPE-5818-C-00-4087-00

PROJECT DATES:

- a. First Project Agreement: PNG-NDOE and EDC 1986
- b. Final Obligation Date: December 1990
- c. Incremental Funding for FY 89: US \$600,000

PROJECT FUNDING: A.I.D. Funding US \$5,319,000

MODE OF IMPLEMENTATION:

Education Development Center (direct contractor)
55 Chapel Street
Newton, MA 02160, USA

PROJECT DESIGNERS:

U.S.AID Bureau for Science and Technology, Office of Education
Education Development Center, Inc.
Friend Dialogues

RESPONSIBLE MISSION OFFICIALS:

Louis Kuhn
Mission Director

Frank Watson
Project Director, 6/87 - present

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BACKGROUND

Innovations within the NDOE are necessary to improving the overall standard of education in the country. However, innovations have followed one after another year after year, creating frustration among the teachers and strain on the system as it struggles to adapt materials and training programmes with very limited resources. This being the case, it is important that the RSPP be sympathetic with the NDOE's perspective of longterm goals and its preference for gradual, systematic adjustment of its programmes.

The NDOE is more modest in its projection of what is possible to glean from RSPP than were the project planners. NDOE tends to look 10-15 years down the line while the RSPP project planners were looking to effect changes within a 4-year period. The project was slow in getting off the ground, leaving a tight production schedule during the later stages. The implication, then, is that NDOE may now be happy to narrow the scope of this project and to complete its ultimate goals through subsequent proposals that may well be funded through other agencies and carry on for some time to come.

Radio broadcasts coupled with hands-on work for the students are seen to cause an attention problem, hence the current shift to hands-on work following the broadcast and to more work using the teacher to demonstrate in front of the class. The *Notes to the Teacher*, then, and in-service workshops take on a much more important role.

There are now positive indications that NDOE is interested in adopting a radio based approach to science at the Grade 4-6 level. This has not always been the case. In fact, the Curriculum Development Division resisted the project in the beginning as being too inflexible regarding its mode of delivery. The current director is largely responsible for opening channels of genuine communication on the strengths and weaknesses of the project and how best to improve it.

There is fear within NDOE that if Grade 6 broadcast materials are not completed now, those brought in to do them later will revamp the whole of Grade 4, 5 and 6 and the value of this project will be lost altogether. On the other hand, if the remaining project time is spent on the Grade 6 materials, there is the danger that the Grade 4 and 5 materials never will be revised.

At its most recent meeting, the national Community Schools Board of Management discussed the institutionalisation of the Radio Science Project and expressed the following:

- a. reservations regarding the costs associated with producing and replacing workbooks for every pair of Grade 4, 5, and 6 science students.
- b. reservations regarding centrally purchasing and distributing additional science kit material
- c. satisfaction with the recent decision to shift toward producing more teacher-directed support material

1.0 INSTITUTIONALISATION

1.1 STRONG ADVOCATE

With competing, justifiable demands all vying for limited funds in a cumbersome bureaucratic system, it is often the case that no rational process of prioritising needs finally governs the allocation of resources.

That being the case, an important longterm factor in the success of integrating RSPP into the NDOE curriculum on a permanent basis is the presence of an influential advocate within the NDOE over the next few years.

NDOE has intimated that it is not beyond its resources to deploy its own officers to assist the project from 1991 and beyond. It is possible then that a position for a science educator (contract officer or volunteer) could be made available although there may still need to be some provision for a salary differential in order to recruit the kind of officer needed to complete the development and revision of the RSPP materials.

This officer should be vigorously pursued jointly by both the NDOE and the RSPP in order to provide as much overlap as possible with the incoming interim director. He should liaise on a regular basis with the various divisions of the NDOE to ensure the full integration of radio science within the curriculum.

There is consensus that the remaining materials must be planned and underway before the new director arrives. The current director could then be invited to retain a role in guiding the project through to its completion even though it may need to be done via computer communications and short-term visits. The new director, then, would serve more in a cooperative relationship than in an independent role, controlling design on his own.

The viability of such computer communications has already been demonstrated within the project through the current director's computer links with the other U.S. based consultants.

It is expected that the two officers would work side by side through the first 6 months of 1991.

FINDING 1: That the RSPP will fail to be institutionalised without recruiting a strong science educator committed to the radio science approach into the NDOE system.

1.2 PROJECT GOALS

In order for the RSPP materials to be a successful means of science instruction, the teacher's role in reviewing previous material and in carrying out the post-broadcast activities is crucial. The observation reports and the director's *Notes On Work Plan Shift* make it clear that the broadcast itself cannot carry the burden of a science curriculum.

This is further supported by the minute from the Superintendent of the Curriculum Development Division to Tom Tilson and Frank Watson (28/3/89) outlining the Curriculum Development Division's scepticism about stand-alone RSPP instruction. There is consensus in the Curriculum Development Division and on the RSPP Advisory Board that more teacher-directed support materials are needed.

The stand-alone strategy developed in the Dominican Republic and elsewhere has not been well accepted here in Papua New Guinea.

Two strong themes that keep recurring in responses from various NDOE staff are:

1. That the RSPP should assist with the revision of the existing Grade 6 science broadcast materials.
2. That the RSPP should give greater priority to assisting teachers to improve their science lessons.

FINDING 2: That science education is fundamentally different from language education and mathematics, that radio broadcasts cannot carry the burden of the science curriculum alone and that science education requires an active role on the part of the teacher in the classroom.

FINDING 3: That NDOE would like more teacher-directed Grade 6 science support materials that can be used as a model for developing similar teacher-directed materials for later revisions of the Grade 4 and 5 radio science materials.

1.3 ACCOMPANYING BENEFITS

Innovative projects like the RSPP are more likely to be institutionalised in a complex system like the education bureaucracy here if the project is seen by departmental decision-makers to have spin-off benefits other than the stated objectives of the project.

Benefits that NDOE happily expects to take away from the project include:

1. a revived, fully functional schools broadcast studio
2. trained scriptwriters that can be absorbed into the system; some to school broadcasts and some to curriculum writing.

The Materials Superintendent refers enthusiastically to the submission jointly prepared for rewriting the scripts for all radio broadcast materials currently being aired and for a more functional broadcast studio.

Thanks to the script-writing training currently going on in the project, the Curriculum Development Division is now enthusiastic about incorporating scriptwriters trained during the project into their unit. RSPP is also producing growing experience in curriculum development, administration and teacher training.

NDOE hopes to find ways to incorporate the skills being developed during the RSPP into providing radio assisted in-service training for teachers in science and other core subjects as well.

At the same time, the original project proposal (Galda/Chaytor 1985:3) calls for limited use of the project for nonformal adult education broadcasting at later hours. With the promotion of adult literacy now part of the agenda of the Curriculum Development Division, the use of some of the scientific material related to practical agriculture, health, nutrition and community life for adult learning could increase the worth of the project to the NDOE.

FINDING 4: *That the RSPP is generating spin-off benefits that are valued by NDOE.*

1.4 CAPACITY BUILDING

The ability of the RSPP staff to carry on and complete the project depends a lot on holding existing staff together.

It is obvious to all that not all staff will be absorbed by the Curriculum Development Division. Less than half of the current 17 Papua New Guineans on the staff list are likely to be absorbed into the Curriculum Development Division. With this insecurity, trained staff can easily be tempted to accept other positions outside the project simply because they are permanent.

RSPP is sometimes criticised for being overstaffed for the level of production involved. The higher staff/production ratio is necessary, however, in a project whose limited duration necessarily combines training and intense production with job insecurity and inevitable turnovers. The recent acquisition of two former inspectors has given the project new credibility in terms of staff quality.

The contract agreement's call for the training of a counterpart primary school science education specialist is still a problem. Although the new science education associate is very capable and quickly learning the art of breaking science units into appropriate segments, he has been outside the profession living in the village for the last ten years and may well find it difficult to complete the Grade 6 production schedule without the support of a good science educator.

The identification of segments suitable for covering unit topics of the syllabus depends on analytic skills and considerable science background, particularly where physical science is involved. The scriptwriters rely heavily on the backup support of a science educator as well.

FINDING 5: *That the RSPP does not yet have a trained primary school science education specialist to leave behind as called for in the contract agreement.*

FINDING 6: *That turnover of staff may continue to be a problem with so few permanent positions becoming available within the Curriculum Development Division once the project folds.*

1.5 COMMITMENT OF RESOURCES

There are several key factors that point to a growing commitment on the part of NDOE to incorporating the RSPP into the Curriculum Development Division. These include:

1. The inclusion of K75,000 for materials in the Public Investment Programme approved for Curriculum Development and Distribution 1989-1994.
2. Plans by the Field Service Unit of the NDOE to cooperate with RSPP in developing an in-service training programme that concentrates on science during 1991 (following a focus on English in 1989 and maths in 1990).

3. A willingness on the part of NDOE to hire a science educator to follow up and complete the development and revision of RSPP from 1991.
4. The joint preparation of a new Public Investment Programme submission which funds scriptwriters along with staffing and maintaining a more efficient school broadcast studio.

FINDING 7: That NDOE is interested in adopting the RSPP approach nationwide but will remain uncertain until questions regarding costs, the reach of radio and teacher-directed support materials are resolved as per additional findings below.

1.6 ADD-ON COSTS

The project description calls for a detailed implementation plan on how this programme can be used on a nationwide basis in both the formal and nonformal education sectors, minimizing future recurrent costs for the Papua New Guinea government.

As yet, no serious projection of the add-on costs required for assimilating the RSPP has been attempted. This is due, in part, to the evolving design of the project, an evolution which is justifiable and, in fact, necessary if the project is to be made compatible with the national system.

So while the *Sub-Projects for Curriculum Development and Distribution* in the Community School Public Investment Programme for 1989-1993 has been approved, it was basically approved 'in principle', not on the basis of projected add-on costs.

The figure of K75,000, then, is an indication of NDOE's support for the direction that the RSPP is heading rather than a firm commitment to assume responsibility for the total costs of running the programme under its original design on a national scale.

On the whole, NDOE officials are not optimistic about centrally distributing student workbooks and/or inexpensive science kits on a 1:2 basis for all Grade 4, 5 and 6 science students nationwide.

Experience with reusing broadcast workbooks over several years has been problematic, some books disappearing and others being marked and torn. Current practice in trying to provide workbooks in support of other school broadcasts is to provide one sample book for each class. It is then up to the local board of management to find a way to duplicate or photocopy the material for other students to share. This, unfortunately, disadvantages students from the less developed areas, the polar opposite of the project's objective on equity.

Books for individual students have been centrally distributed through the recent World Bank programmes, but the aid donor took responsibility for the initial distribution, with NDOE accepting responsibility for replacement costs. While this has been agreed to, the programmes are new and have not yet affected recurrent budget funds for the NDOE.

The science kit material presents a similar problem. While there was one central distribution of science kits back in the early seventies, there has been considerable reluctance over the years since then to fund such kits centrally. Currently, each school must pay for their own science kit. While several hundred such kits have been sold in recent years at a cost of about K210, a large percentage of the more rural schools have been denied access to science literacy through lack of resources.

There is some support at the moment for providing a simple science kit of largely replaceable materials on the grounds that science is a core subject prescribed at the national level which the national government is then obliged to look after. However, it is not likely that the national government will assume responsibility for centrally funding science kits of the kind currently available.

NDOE's Overseas Aid Section is confident that, if given the opportunity, they can reduce the price of any science kit agreed upon, through special tenders.

Studies projecting low recurrent costs per student-year like that described by Jean Meadowcraft for Nicaragua and Dominican Republic are unlikely in the Papua New Guinea context. Both distribution and production costs here are high.

Costs for broadcast time may add yet another expense. As the National Broadcasting Commission is in serious financial difficulty, a ministerial review committee has been established to make recommendation on its future. The committee is looking at a variety of ways to assist the National Broadcasting Commission to generate revenue. One such measure has been the call on the NDOE to prepare a budget to pay for the air time currently used by school broadcasts on the National Broadcasting Commission.

Should this recommendation be adopted, six science broadcasts a week plus any teacher-directed broadcasts that may result must be taken into consideration when calculating the add-on costs of implementing the RSPP on a national level.

This initiative by the National Broadcasting Commission has been opposed before and will be vigorously opposed again this time, but the National Broadcasting Commission's financial difficulties are now so serious that some strong remedial action is almost certain to be adopted.

There has been no suggestion that batteries for radios would be provided centrally.

Currently, a series of cassette tapes provided for other programmes by the schools broadcast unit costs K50 for 24 cassettes and postage. If cassettes are used in lieu of broadcasting over the Karai services in areas where there are difficulties in receiving those services, the corresponding increase in add-on costs will be significant.

FINDING 8: That it is not yet clear that the materials now being developed for RSPP instruction are cost efficient and applicable to other less developed countries as required by the DOE-EDC contract.

2.0 PRODUCTION

2.1 STUDIO PRODUCTION

The early history of the project was marked by a variety of technical difficulties related to the repair of equipment, maintenance service and engineer training. There are still some technical difficulties hampering the efficiency of the system such as the hiss in the cartridge machine, the 12-slate copier operating below capacity, the lack of adequate sound-proofing, the overheating console and the needed power supply. Maintenance and critical spare parts are the most critical. But recording is possible and the general situation has greatly improved.

Two important steps in that improvement process were the hiring of a RSPP engineer who now concentrates entirely on RSPP broadcast productions and the complete overhauling of the broadcast studio by the National Broadcasting Commission at the end of last year.

The schools broadcast studio came into being as a result of the failure of National Broadcasting Commission to meet the expectations of the Curriculum Development Division. With no means of improving on the capability of that agency to perform, NDOE chose to take on the function themselves and, in so doing, soon discovered the difficulties involved in producing quality school broadcasts on a regular basis.

Last year, an agreement reached with the National Broadcasting Commission to revamp the schools broadcast studio resulted in marked improvement to the schools broadcast studio. More recently, the new Public Investment Programme submission has been prepared to build and maintain the capacity of the school broadcast studio to regularly produce good broadcasts.

In addition, the ministerial review committee is currently reviewing broadcast policy in Papua New Guinea with a view to consolidating services and bringing government-sponsored video, radio, and print productions under the umbrella of one national agency. Attention is being given to the growing number of aid-sponsored audio/video studios that have been set up but little used because of a lack of maintenance and technical skills in Papua New Guinea to keep them operating.

Considering the current momentum for consolidating such production facilities, it is not unlikely that the Government will opt to maintain scriptwriters and content-control for media productions within specific departments but to consolidate the audio/visual production studios into one central facility that is properly staffed and maintained.

The Public Investment Programme submission for *Support of Curriculum Materials Using Radio and Television 1990-1994* would then need to be modified accordingly.

2.2 PRODUCTION SCHEDULE

The current project director has expressed his concern that it has been not been possible to revise the Grade 4 materials in a quality form at the same time that Grade 5 lessons are being produced, given the limited time available.

Timing in the production schedule has been a problem right along. All staff work to a tight schedule in order to keep the broadcast schedule from falling behind. This means that everyone works under considerable pressure and that any unexpected delay in the production process threatens to upset the classroom broadcast schedule.

The teacher support broadcasts are weak to date simply because of the time that has gone into producing and revising the other materials. The current production schedule for Grade 5 is also tight although the the schedule is currently 10 lesson plans ahead, partly because of good help coming from one of the staff now drafting segments. This could free the director to spend to turn more attention to the preparation of teacher training materials.

Some classroom teachers have asked for more lead time between the point when the materials are delivered and the date of the broadcast. The tight schedule makes it difficult for them to adequately prepare when the materials arrive so late.

FINDING 9: The RSPP production schedule is too tight to allow for adequate researching of unit topics, creative use of the actors in relating the syllabus to practical community life, proper attention to the production of teacher-directed support materials and proper incorporation of the results of the formative evaluations.

2.3 SCRIPTWRITING

The scriptwriters are widely applauded within NDOE as a welcome and needed addition to the Curriculum Development Division.

The writer's workshops that have been going on since September have been designed to prevent scripts coming out with too much focus on content and not enough on the interactive reinforcement.

One staff evaluator, however, suspects that the writers, left on their own, will fall back into mechanically transposing the segment outline into the script format without creatively scripting the message into the interactive mode. This leads to scripts that lack the imagination and creativity the interactive method tries to establish in order to captivate the students attention. Part of this is undoubtedly due to the tight production schedule.

Early indications from the summative evaluation are that the scriptwriters sometimes assume science background that would better be repeated than assumed. This may be due, in part, to the higher standard of teachers in the area of the formative schools as opposed to the more rural summative schools of the East Sepik.

When the science terminology is adequately broken down for the scriptwriters, the standard of the script is also much better. The staff evaluators agree that more than one-page of background on the segments of a unit is needed in order for the scriptwriters to produce an effective script.

Care must be taken to ensure that the scriptwriters and actors are given as much background information as possible. Current project design does this by providing short, clear science notes for the writers, lesson planning meetings with the science educator and then writer planning meetings. Writer background is further strengthened by actually doing themselves all the science activities they write about.

This has not always been the case however. It was not until late 1987/early 1988 that full time writers and actors were employed and the key science education, producing and scriptwriting functions distinguished. From that point, the major task for the associate science educator has been science education, the major task for the associate producer has been producing and the major task of the chief scriptwriter/producer has been scriptwriting.

FINDING 10: That some cyclic reinforcement of scriptwriting principles will be needed for some time before the scriptwriters are fully independent.

2.4 LANGUAGE

Both classroom teachers and staff evaluators confirm that the standard of English in the RSPP materials is too difficult for the average Grade 4 or 5 student in the nonurban areas of Papua New Guinea.

One Port Moresby area teacher reported that her class was evenly divided between a faster and a slower group and that the language standard was appropriate for the faster group only. Standards for English in the rural areas can be expected to be even lower.

The staff evaluators agree that it would be better to restrict the standard of English to:

- a. basic active sentences
- b. trimming the metalanguage to basic equivalents, and
- c. repeating definitions of terms even if prior explanations have been given.

New terms sometimes need repeated explanations. Violet and indigo, for example, are generally unfamiliar to speakers of English as a second language. Boxes vs. squares and generic terms like 'objects' and 'image' are other expressions that frequently cause difficulties in many parts of Papua New Guinea.

The use of directional terms presents a particular problem. To give instructions on how to place an object on the worksheet, for example, is difficult for the radio teacher who has no points of reference within the classroom itself.

For example, in Grade 4, Unit 5, Lesson 46, the radio teacher's instruction is to look at the first colour of the rainbow in the box, but it is not clear from a crosscultural point of view what is meant by the 'first' colour. Is it the one at the bottom or the one at the top?

In the same lesson, the radio teacher asks the class to use the mirror to complete the pictures in boxes 5 to 10. In 6, for example, the instruction is to use the mirror to make a comb that has no broken teeth. But without clear directionals, it is difficult to know how to place the mirror near the image in such a way as to create the desired affect.

Partly because of such problems, the Grade 5 materials have shifted away from hands-on activities during the radio lessons, leaving them to the teacher to do as dry lab experiences during the post-broadcast portion of the lesson.

Some teachers have asked for a glossary to be developed for the *Notes for the Teacher* to help build familiarity with unfamiliar scientific terms.

FINDING 11: *The standard of English required for RSPP materials is too high at times.*

2.5 ACTING

The use of actors/actresses is a powerful learning device that is one of the strengths of the interactive radio approach to science learning. While the actors do refer back to community life and culturally familiar items and events from time to time, a more relaxed production time-line would make it possible to exploit their potential more fully.

3.0 BROADCASTING

Radio has not been a priority with NDOE in recent years. The last significant funding for radio was during the series of World Bank sponsored education projects. However, with

the sudden departure of the school broadcasts' coordinator at the end of 1984, support for school broadcasting has been poor.

Some radio scripts are now 25 years old and much of that material is now completely unrelated to the current curriculum. The English language broadcasts developed during the sixties, for example, are still in use despite the fact that the approach to language learning used there has since been abandoned as ineffectual.

However, the RSPP and its success with scriptwriting and material production has demonstrated the power of radio as a medium for learning in the Papua New Guinea context. This has generated new enthusiasm in the NDOE such as that expressed by the Superintendent of the Materials Unit through his Public Investment Programme proposal to rewrite all school broadcast scripts and improve broadcast production.

FINDING 12: That the RSPP has been influential in generating new support for the role of school broadcasts in primary education in Papua New Guinea.

3.1 LIMITATIONS OF BROADCAST HOURS

Audience research for radio has been poor in Papua New Guinea. There is no research that has sampled conditions in various parts of the country over the seasons of the year. It is well-known, however, that radio services are erratic with isolated pockets where reception is always difficult and others where reception is good only at certain times and under certain conditions.

The Director for Engineering Technical Services for the National Broadcasting Commission advises that provincial services are not capable of broadcasting during daylight hours. It is hoped that the current restructuring may lead to improvements that could result in daylight broadcasting from provincial stations. But the review is still in progress and the outcome is uncertain.

School broadcasts take up much of the morning scheduling for the Karai services at the moment. Currently, two of thirty one broadcast slots are reserved for science broadcasts. Two broadcasts per week for each of Grade 4, 5 and 6 would require an additional four broadcast slots. Slots that are still open are the less attractive ones, either because they are late morning when reception is difficult or on Fridays, a day that tends to attract a lot of interruptions to class schedules. One weakness in the original project proposal was its reliance on the use of afternoon hours in the broadcast schedule.

FINDING 13: That the scheduling of the full range of radio science programmes will require further negotiations with the National Broadcasting Commission.

3.2 RANGE OF RECEPTION

Among the findings of the 1987 *Board of Inquiry Into Broadcasting (Including Television)* is the conclusion that radio coverage in Papua New Guinea is grossly inadequate and, in much of the country, nonexistent altogether. Radio coverage and transmitter failure were the most common problems identified by the public during the hearings. Given the lack of any carefully sampled survey data, this record of the hearings during the inquiry is an important indicator of the current limitations to radio coverage in Papua New Guinea.

The study expresses concern over specific examples where even the Karai Services with its seven relay centres cannot be received, including Alotau (the provincial centre for the Milne Bay Province), various points in the Western Province, East and West Sepik, Manus, North Solomons, Enga and others.

Provincial stations are even more limited with their 2 to 5 kw transmitters covering roughly a 50-80 km radius, depending on a range of technical factors including the conductivity of the soil and the conditions of the ionosphere.

One longshot projection is that Papua New Guinea will gain a huge 50 kw transmitter through overseas assistance that would be set up near Lae and enable complete coverage nationwide. No such package has been negotiated as yet, however.

A survey on school broadcasts was attempted in 1983. The data is of limited value, however, because it relies on return mail in a situation where the remote areas with reception difficulties have distribution difficulties as well and may not have received or may not have been interested in the questionnaire in the first place. Nonetheless, the survey results have value simply because so little data on radio reception of any kind exists.

Most provincial stations cannot broadcast during the late morning and early afternoon hours when children are normally in classes. This is true in spite of the Japanese funded boosters now being put in place to improve the reach of some of the provincial stations. For this reason, broadcasting in Central Province has not been possible. Instead, cassette tapes have been used.

Although the original proposal states that the project would explore, during the life of the project, other sources of funding for the strengthening of transmission lines, no progress has been made as yet.

FINDING 14: That too little is known about the range of radio reception in Papua New Guinea to assess whether or not the RSPG will be able to provide inexpensive, effective primary radio science instruction to the targeted rural areas of the country.

3.3 DISTRIBUTION OF CASSETTE TAPES

Any use of cassettes depends on effective distribution which is often difficult under conditions in Papua New Guinea.

To ensure delivery in the Wewak summative evaluation scheme, all cassettes were hand-delivered to workshop participants who had gathered in Wewak prior to the launching of the programme. Each participant then carried the cassettes back to their community school location. This is obviously an artificial solution.

Education materials have traditionally been delivered to the schools through the provincial offices of education. The method of distribution varies from area to area but it is not uncommon for a pigeon-hole mail slot to be kept in the provincial office for each school.

It is normally the responsibility of the Provincial Materials Supply Officer (PMSO) to coordinate the distribution of materials. He must record the supply given to each school and follow-up with an assessment of what is currently available at each school. The effectiveness of his coordination often depends on informal communication at the marketplace, church, pubs, etc. regarding who happens to be going to particular rural areas.

Such informal coordination works reasonably well for schools along well-travelled routes with good roads or frequent air/shipping links. However, the system breaks down for the more remote schools. Some schools get their supplies only once or twice a year when the teacher/headmaster himself manages to get to the provincial centre.

In addition to the necessary dependence on informal coordination, regular school material supply is sometimes processed at two or three sub-centres before reaching the target school. After delivery to the central provincial office, the materials may go to a district office, then perhaps to an area centre which finally distributes to a cluster of schools. Time lags through such a series of steps are inevitable, although the materials can still move rather quickly where transport is more efficient.

The conclusion here is that the distribution of cassettes (and other material) via the traditional means of distributing school materials is slow for the rural schools.

The obvious alternative, of course, is to use the Post and Telecommunications Services. Efficiency in the postal service in Papua New Guinea has increased significantly in recent years. The number of remote outstations receiving regular mail bags in care of local businesses, schools or churches has risen sharply. There are still some locations, however, such as coastal villages in the Western Province where there are no fortnightly or even monthly transport services.

Currently, a significant percentage of paycheques are being sent through the post. Cost may be prohibitive, however, if the mailing of cassette tapes becomes large-scale.

A possible solution currently being debated here is government subsidy of postal rates on educational material. Other government agencies are also asking for subsidised rates for the distribution of educational and awareness materials in an effort to promote national unity, law and order and rural development.

The RSPD proposal ruled out the distribution of cassettes but, at the same time, failed to identify any effective means of broadcasting in areas where radio reception is poor.

FINDING 15: That distribution costs cannot be calculated until some estimate is made on what percentage of community schools can receive the Karai services and then, conversely, what percentage will require cassette tapes.

3.4 AVAILABILITY OF BATTERIES

Questions still remain regarding the availability, shelf life and cost of batteries necessary to maintain the broadcasts. There has been no suggestion that batteries will be centrally provided.

One experiment is currently being conducted in the East Sepik summative evaluation in which half of the schools have been provided with fresh torch batteries while the other half have been given vouchers for purchasing their batteries through the local trade store where shelf life could turn out to be a problem.

There are frequently times when the boards of management are out of funds or refuse to purchase yet another set of batteries. In dealing with the battery problem, some teachers report having used their own money to purchase the batteries. One teacher charged each student in the class 5 toea to recover the cost of the batteries.

It is the remote schools that the project is designed to reach and yet it is the remote schools that have the greatest difficulties in obtaining batteries.

FINDING 16: *That it is still an untested assumption that rural community school boards of management will be willing and able to provide the batteries necessary for maintaining the RSPP broadcasts on a regular basis.*

3.5 AVAILABILITY AND USE OF RADIOS

The school broadcasts unit has already circulated a bulletin on broadcast capabilities, duty free prices and related procedures for obtaining preferred radios through a recommended supplier.

There is some concern that the project has fostered a new dependency by providing radios to the schools involved in the pilot project when most schools already have at least one radio purchased by their board of management.

The radios provided by the RSPP project have been criticised in both the Central and East Sepik provinces as being less powerful than the school radios purchased by the Boards of Management.

The question now is whether to recall the radios already distributed or simply leave them for whatever use the schools may choose to make of them. Considering the ill-feeling that would result from recalling the radios at this point, it is probably best to simply leave them with the schools.

3.6 AVAILABILITY AND HANGING OF ANTENNAS

Experience in the East Sepik has shown that schools without antennas or with antennas that are not positioned properly have difficulty in picking up the fairly weak provincial station. Schools need assistance in order to properly hang their antennas. Staff who travelled to the East Sepik schools early in the year did not take enough time to complete the job for the pilot schools with the result that some schools do not receive a strong enough signal to make sense of the broadcasts.

The National Broadcasting Commission's Karai service is stronger, however, and will enable a wider reach if the science broadcasts are institutionalised and broadcast over the Karai service.

There will still be areas that require antennas, but fewer of them. It is expected that this cost will continue to be born by the local community school boards of management.

FINDING 17: *That antennas and instructions on how to install them will be needed by many rural community schools.*

4.0 CURRICULUM DEVELOPMENT

4.1 CURRICULUM CONTENT

Classroom teachers are enthusiastic about the radio science materials and consider them an improvement over the current science teachers' guides. Teachers feel the new material is much clearer and easier for them to follow. Many teachers confessed to simply skipping much of the older material because it was too difficult to follow.

Science as with other areas of the primary school curriculum has been questioned regarding the relevance of its curriculum for rural community life to which most school leavers must return. Accordingly, the education development plan calls for matching exposure to the international science world with the practical aspects of agriculture, communications, health, transport and community life in Papua New Guinea.

The curriculum is further constrained by the requirement that it follow the current curriculum outlined in the *Science Syllabus for Community Schools*.

Even given these constraints, however, there is widespread acceptance of the content and value of the RSPP curriculum. It is the pedagogy that has attracted attention rather than the curriculum content.

FINDING 18: That there is general acceptance of the content and value of the RSPP materials being produced over the science materials currently being used in the system.

4.2 RSPP PEDAGOGY

There is good support for the RSPP strategies of providing support systems for teachers, of developing instructional materials that reflect the pupil's daily experiences, of outlining post-broadcast activities for applying their new knowledge and of developing the model through rigorous formative and summative evaluation.

The areas of concern relate to the more controversial 'stand alone' and 'hands on' strategies discussed above under 1.2 PROJECT GOALS and below under 5.2 INTERACTIVE RADIO SCIENCE LESSONS.

4.3 SELECTION OF GRAPHICS

There is considerable variation in the quality of the graphics used in the worksheets, although they have improved considerably since the project acquired its own full-time artist who has been able to give his full attention to the needs of the project.

Line drawings such as the one below, for example, are frequently misinterpreted in many parts of Papua New Guinea. Testing has shown that, unless clothes on line figures are shaded, these figures are thought to be wearing ornaments only, the lines meant to mark sleeves, neckline, waist, etc. being interpreted as armbands, waist bands, etc.



Similarly, line drawings like the above on their own, given the lack of any graphic distinction between the surface of the ground and open space, leaves the line figures to be interpreted as suspended in open space.

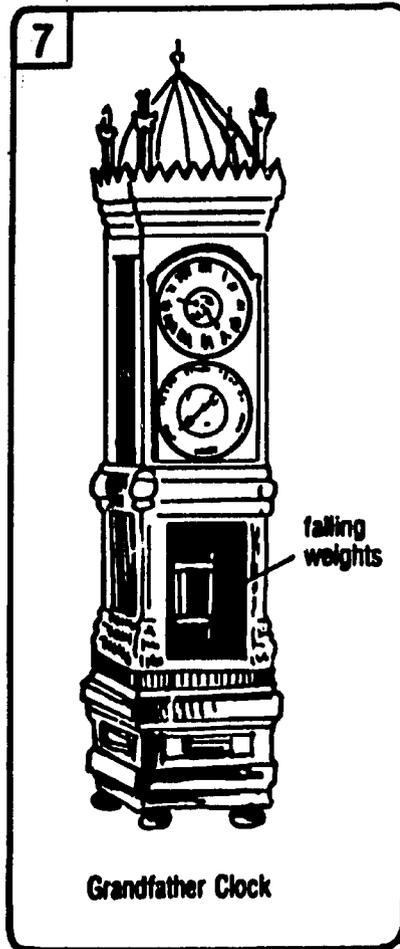
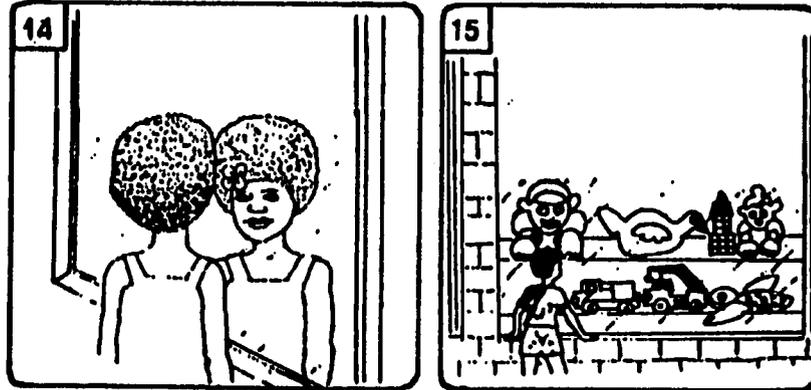
Later work has given more detail to the graphics as in the house of #4 below.



Even with the minimal line drawings, the context of the presentation normally fills in what is not represented in the graphic.

19x

It is difficult to ensure the relevance of all graphics to the everyday experience of the students, given the wide range of variation in exposure to Western lifestyles. Students living along roads that access the national capitol are not typical of the majority who would not be familiar with large mirrors (14), grandfather clocks (7) or store windows filled with toys (15).



The questionable images are few, however. They are not essential to the basic principle of the unit and can easily be changed in later revisions.

FINDING 19: *That some graphics which are easily interpreted by most people in the Central Province, where the formative evaluations take place, are likely to be much more difficult to interpret for people in the more remote areas of the country.*

4.4 NONFORMAL EDUCATION

The RSPP proposal originally submitted to the NDOE (Galda/Chaytor 1985:3) provided for a link between the formal and nonformal education sectors:

THE PROJECT WOULD STRIVE TO MAKE SOME OF ITS BROADCASTS SUITABLE FOR OUT-OF-SCHOOL AUDIENCES. THESE BROADCASTS, HEAVILY EMPHASIZING PRACTICAL APPLICATIONS, COULD BE USED WITHOUT A CLASSROOM TEACHER OR OTHER FACILITIES. THE BROADCASTS COULD BE RE-TRANSMITTED AT A CONVENIENT HOUR AND, IF NECESSARY, TRANSLATED INTO OTHER LANGUAGES. THEY WOULD BE SUITABLE FOR DISCUSSION GROUPS IN THE COMMUNITY RESOURCE CENTRES BEING ESTABLISHED BY THE NONFORMAL EDUCATION SECTION. THE PROGRAM CAN SERVE AS A LINK BETWEEN THE FORMAL AND NONFORMAL EDUCATION SECTORS.

Radio, using the interactive approach with radio actors, should be a powerful tool for nonformal learning as well. Its under-utilisation in Papua New Guinea is due in part to the lack of a viable strategy for exploiting its potential as a good learning tool. As the RSPP is bringing such a tool to the country, it presents an opportunity to trial the approach for transferring important knowledge to out-of-school youths and adults at the same time.

Cash-cropping is an important area where adult farmers are anxious to gain scientific agro-chemical knowledge about how to improve their production. This knowledge needs to be balanced with food production (nutrition) and safety precautions (health), all areas outlined in the proposal for applying scientific knowledge to everyday community life.

With newly approved initiatives within the Curriculum Development Division for improving literacy skills among out-of-school youths and adults, this is an opportunity to trial transferring practical scientific knowledge and building reading skills using radio actors, the radio teacher concept and community discussion groups.

FINDING 20: *That time constraints have prevented the project from testing the radio science instruction for out-of-school youths and adults as outlined in the project proposal.*

5.0 SCHOOL USE OF MATERIALS

5.1 NOTES FOR THE TEACHER

Teachers have repeatedly expressed satisfaction with the RSPP *Notes for The Teacher* as compared with the standard science teacher's guide.

Considering the reading background of many of the teachers in the rural areas of the country, greater attention needs to be given to the presentation of this material, varying type styles, print styles, creating attention-getting black patches, blocks with sub-headings, themes boxes and graphics. Consultant staff are currently working on these aspects of the teacher-directed materials, creating greatly improved layouts.

Even if further teacher-support materials are prepared, there is the additional problem of ensuring that they are used. Experience in Papua New Guinea bears testimony to the fact that teachers fail to make use of much of the teacher-aid material.

Cassette tape learning for teachers has some of the same problems. Such learning is individual-oriented, isolating the teachers from one another in a cultural context where shared learning experiences are valued. Distribution of the cassettes to the rural areas is another factor, of course, but even apart from that, most teachers will take only limited time to read or listen to new information apart from the minimal class preparation time.

A newly approved Public Investment Programme covering in-service training has given much needed support to a long neglected area of teacher training. Plans call for 2-3 day workshops for 30 or 40 participants (the school inspector plus one selected teacher for each inspectorate). It is up to these two, then, to run their own in-service courses for the classroom teachers back in their inspectorate. It is important that the teacher workshops and teacher-support broadcasts associated with the RSPP should be made consistent with the new staff development policy and in-service training programmes developing out of it.

Some concern has been expressed that innovations like the RSPP require closer collaboration between curriculum designers and in-service trainers than was practised in the early stages of the project if such programmes are to be institutionalised on a national level. Such collaboration has now been established and is developing well.

This could be the means whereby new models for in-service training can evolve that combine the strengths of experience in the Papua New Guinea context with the strengths of the RSPP approach to teacher-training activities.

FINDING 21: That, until recently, RSPP teacher training and NDOE in-service training were heading in different directions.

5.2 INTERACTIVE RADIO SCIENCE LESSONS

The broadcast tapes are widely accepted and appreciated in spite of the fact that they clearly do not carry the burden of the curriculum as originally hoped. In some places, science is being taught for the first time as a result of the response to these materials.

In the earlier materials, observations showed there was a problem in controlling the attention of the pupils who were having difficulty deciding whether to focus on the worksheets, the teacher or the radio.

That problem has now been largely eliminated by the current practice of trying to limit student activities during the broadcast, leaving any hands on activities to the teacher-directed post-broadcast period.

Teachers report that occasionally a tape will revert to a slower speed for a short period and then pick up again, indicating some technical problem during recording. Instances of this are infrequent and not a serious problem.

Some teachers complained that the voices of the child actors/actresses 'blare', that the pitch is too high and too strong compared to the other actors'/actresses' voices. This was not a consistent complaint, however, and may be attributed to the quality of the radio receiver being used in particular schools rather than to the production quality of the tape as there

was noticeable variation in the voice qualities of the child actors/actresses even with the same broadcast in different classrooms.

There is also some concern that the post-broadcast activities are sometimes too time-consuming and take away from other important school activities. This can be curbed if necessary.

5.3 RADIO SCIENCE LESSON WORKSHEETS

In what is intended to be a cost-saving measure, folders of worksheets are distributed one to every two students. These are then collected and stored following each science class. Students are requested not to mark on the worksheets. In practice, however, the worksheets frequently wind up crumpled or dirty. Some are lost or taken away. Only a percentage of the materials remain reuseable.

RSPP staff overextended themselves in trying to revise the Grade 4 materials and get them to the summative schools in the East Sepik by early February with the result that the worksheets still have a lot of errors. This concern was part of the motivation behind the proposal to cut back on the production of new material in favor of revising some of the earlier work during the last 20 months of the project.

The worksheets are vital to the radio science approach. It is possible, however, that they will be treated the same as other school broadcast workbook material, one copy being supplied to each school, leaving it up to the school's board of management to find a way to duplicate or photocopy the material to be shared amongst the students.

FINDING 22: That NDOE is concerned that the cost of producing and maintaining work-folders or workbooks for every two science students in all 2300 community schools in Papua New Guinea is likely to be prohibitive.

5.4 SCIENCE KITS FOR LESSONS

The pilot project may have set a difficult precedent by supplying additional science kit material free of charge. The science kits currently being distributed must be purchased by the local school.

Pilot project teachers, according to the staff evaluators, are delighted that they are finally being provided with appropriate materials. It is not likely, however, that the national government will provide science kits of the type now available to all community schools.

The project as it now stands calls for a limited number of additions to the science kit which sells for about K210. There is a certain degree of tension here between past project experience and the clause in the project description that states: "in no case would we require purchase of additional equipment beyond the science kits already distributed by the Department" (Galda/Chaytor 1985:11).

Teachers report that even very simple items thought to be available in the local community are often difficult if not impossible to get. For example, simple plastic cups often used for ice-blocks, are sometimes available and sometimes not. The local stores near Avababina Community School were out of stock at the time of the lesson that called for them so the experiment was skipped. But many rural areas would have no refrigeration in any case and, therefore, no ice blocks at any time.

The science kits are meant to be reusable, but like the worksheets tend to get abused and pieces lost. They should be limited primarily to items that can be easily replaced.

Because of the cost involved in supplying hands on science kits in all 2300 community schools in Papua New Guinea, the project is now turning to experimentation with dry labs wherever possible. The teacher carries out the experiment during the post broadcast activities while the students watch. It is difficult to eliminate kit materials altogether, however, especially for the physical science portions of the syllabus.

In order to be equitable and ensure that the science programme reaches the more rural schools, a minimal science kit largely of locally replaceable materials purchased collectively through tender and centrally distributed to all schools may be the only solution.

FINDING 23: That NDOE is concerned that it will be too expensive to provide each pair of Grade 4, 5 and 6 students in all 2300 community schools with science kit materials like those used for Grade 4 science.

5.5 DISTRIBUTION OF LESSONS AND KITS

The distribution of lessons and kits faces the same problems as those discussed under 3.3 on the distribution of cassette tapes.

The problem of distributing materials in the rugged hinterlands of Papua New Guinea escalated during the recent World Bank funded Education II and III projects. There is still no way of knowing which schools actually receive materials leaving Waigani, especially in remote areas where distribution patterns involve third and fourth agents such as local businesses, mission aviation aircraft or church education personnel.

Nor is there adequate information on how long it takes such materials to reach their final destination when they do arrive. Details of provincial distribution plans are sketchy or unknown at Waigani.

FINDING 24: That there is no guarantee of learning gains in the targeted rural schools until there is reasonable assurance that the workbooks, Notes to the Teacher, kit materials, antennas and possibly cassettes actually reach these schools.

5.6 TEACHER SUPPORT BROADCASTS

The director's recent *Notes on Work Plan Shift* suggests a variety of teacher directed support materials including:

- a. revised *Notes For The Teacher* including additional follow-up activities.
- b. a new set of special *Notes For The Teacher* that give in-service support and help with post broadcast activities.
- c. a set of in-service cassette tapes expanding the *Notes For The Teacher*.
- d. two 10-15 minute teacher broadcasts per week with

help on the radio lessons

At the same time, however, the inspectors are sceptical about the value of additional teacher support materials in the long run, at least those that the teacher is expected to use on his own. From their experience, they feel the teachers will not listen to an additional tape or find time to take advantage of additional written materials. They feel the most the project can hope for from the teachers is the time they will need to invest in reading one well-prepared set of teacher notes and preparing for any post-broadcast activities suggested there.

Part of the reason for this is that science does not have the same status as other core subjects such as English and maths. Expectations for progress with English and maths are high both within the education system and without. As a result, teachers will spend more time preparing for English and maths than they will for science.

Results of the 1983 School Broadcasts Survey show that *Education News* is the most popular and regularly followed of all school broadcasts. This being the case, *Education News* can become a good medium for making spot announcements to the teachers about the current radio science schedule or even a quick reference to a good post-broadcast activity for that week's science unit. Additional teacher-directed broadcasts are not apt to get as big a following.

Cost factors would training workshops exclusively for radio science apart from other in-service training. In-service training, as mentioned, has recently been given a boost in budget support and the RSPP staff have begun dialogue with Staff Development Unit and the In-Service College to find ways to incorporate the needed radio science teacher training within the currently expanding teacher in-service training programme.

While workshops have the advantage of face-to-face dialogue and group interaction, they must be given first at the inspectorate level and then at the community level, the problem being that some inspectors fail to do their local-level, in-service training.

Nonetheless, RSPP staff have begun preparing materials for these workshops. The trial materials use graphics with limited text in an attempt to produce materials that teachers are more likely to use. It has been proposed that two of the existing scriptwriters be diverted to this new task which will mean extra time and energy going into training for such scripting. Once done, however, this approach could prove to be valuable to in-service teacher training generally, both in the Papua New Guinea and elsewhere.

While the feeling in Waigani is that more teacher-directed training materials are urgently needed, the feeling in the community schools is that many teachers are already getting better science training than they have ever had before even with the RSPP model as it is now. In fact, the project proposal stresses that the classroom broadcast itself can become an effective, indirect medium of teacher training.

Apart from the workshop materials, it may be necessary to compromise then and provide but one simply written and well-illustrated set of teacher-directed support materials that both build-up the teacher's background knowledge and assist him/her in preparing the post-broadcast activities lesson by lesson.

FINDING 25: That the proposed shift in focus toward teacher-directed materials may easily result in the preparation of more teacher aids than the teacher will find time to use.

6.0 EVALUATION

6.1 CLASSROOM OBSERVATIONS

Evaluation is tightening up as the project progresses. Evaluation staff are now capable of running workshops on critical observation. The reports and their summaries are well organised so that segments that need special attention are easily pinpointed. The observation recording device itself has been revised following gaps picked up in the formative records.

All staff participate in the classroom observation exercises which provide an opportunity for all involved to evaluate their work. Early observations found pausing and timing constraints that were too complicated. These have been improved as a consequence of the formative evaluations.

Too often, however, the observations have indicated that the pupils do not know what is going on. A lot of the revision that needs to be done is being held up by time constraints. The sound component of the Grade 4 materials, for example, has been rewritten but still has not been recorded.

6.2 PRE-TESTING

The head evaluator conducted the pre-test and analysed the data yielding levels of pre-knowledge that should have been helpful, but, by that time, production was already too far ahead for the new information to be useful.

Staff carrying out the pre-testing were not experienced in how to approach a class with such a test. As a result, students were confused about the meaning of the test and later complained about being examined on material they had not been taught.

6.3 POST-TESTING

The test instrument itself needs refining. Either the test questions are too difficult or science is not being taught as well as projected.

The post-test was trialed in East New Britain and the Eastern Highlands but the pace of production precluded taking time for a good analysis and any incorporation of the findings before the Grade 4 summative testing began.

The test questions, themselves should be somewhat less difficult, given the 42% general mean average in the Grade 4 post-test.

FINDING 26: That further work is needed on the testing tool itself to determine why the post-test scores were not above the 50% mark.

FINDING 27: That test questions should be designed initially in the host country and then sent to Friend Dialogue in South Carolina, USA for adjusting, with follow-up once again back in the host country.

6.4 SPREAD OF PILOT PROJECT SCHOOLS

Concern has been expressed that Central Province conditions are not typical of the country's community schools and that it would have been better to maintain the project in the Eastern Highlands, where for a variety of reasons, the project was eventually withdrawn.

The influence of English and the exposure to Western influences is far greater in Central Province than in any other part of the country. Since the key lingua franca for the Momase, Highlands and Islands region is Tok Pisin, students hear little use of English in their day to day routine outside of school. In the Central Province, however, there is broad exposure to English through easily accessible radio, TV and newspapers, all in an area where English is a competing lingua franca as well.

Further, teachers generally prefer postings in or near the bigger cities with the result that better teachers, with better language skills and more science background are apt to be located in and around Port Moresby.

FINDING 28: That the standard of English and exposure to Western influences is much greater in the Central Province than in any other part of the country.

6.5 LEARNING GAINS

A key indicator of the projects success will be statistically established gains in learning among students involved in the RSPP project classes as against those in the control groups. However, due to the early setbacks in the projects time schedule, the first summative classes have only just begun this year in the East Sepik Province. It will be some time, then, before good comparative data is available.

Early indications from the formative evaluations and from the conclusions of both the Project Director and the Superintendent of the Curriculum Development Division are that statistically significant gains in learning will not be registered until further teacher-directed assistance is incorporated into the programme.

While there is considerable confidence in the educational quality of the radio lessons, there is still general scepticism regarding the learning gains actually achieved so far.

In spite of this, learning gains were reported among students in schools like Porebada where the parents have relatively strong educational backgrounds. The headmaster at Porebada (which had two Grade 4 classes participating in the RSPP last year and two Grade 5 classes participating again this year) reports that, in both cases, students being taught the RSPP lesson are getting the better results.

FINDING 29: That the RSPP must incorporate more teacher-directed support materials before the majority of students receiving the radio science education show significant gains in learning compared to students receiving the Department's standard science education.

7.0 SUMMARY OF FINDINGS

FINDING 1: *That the RSPP will fail to be institutionalised without recruiting a strong science educator committed to the radio science approach into the NDOE system.*

FINDING 2: *That science education is fundamentally different from language education and mathematics, that radio broadcasts cannot carry the burden of the science curriculum alone and that science education requires an active role on the part of the teacher in the classroom.*

FINDING 3: *That NDOE would like more teacher-directed Grade 6 science support materials that can be used as a model for developing similar teacher-directed materials for later revisions of the Grade 4 and 5 radio science materials.*

FINDING 4: *That the RSPP is generating spin-off benefits that are valued by NDOE.*

FINDING 5: *That the RSPP does not yet have a trained primary school science education specialist to leave behind as called for in the contract agreement.*

FINDING 6: *That turnover of staff may continue to be a problem with so few permanent positions becoming available within the Curriculum Development Division once the project folds.*

FINDING 7: *That NDOE is interested in adopting the RSPP approach nationwide but will remain uncertain until questions regarding costs, the reach of radio and teacher-directed support material are finally settled.*

FINDING 8: *That it is not yet clear whether the materials now being developed for RSPP instruction are cost efficient and therefore applicable to other countries as required by the DOE-EDC contract.*

FINDING 9: *That the RSPP production schedule is too tight to allow for adequate researching of unit topics, creative use of the actors in relating the syllabus to practical community life, giving proper attention to the production of teacher-directed support materials and for incorporating the results of the formative evaluations.*

FINDING 10: *That some cyclic reinforcement of scriptwriting principles will be needed for some time before the scriptwriters are fully independent.*

FINDING 11: *That the standard of English required for RSPP materials is too high at times.*

FINDING 12: *That the RSPP has been influential in generating new support for the role of school broadcasts in primary education in Papua New Guinea.*

FINDING 13: *That the scheduling for the full range of radio science programmes will require further negotiations with the National Broadcasting Commission.*

FINDING 14: *That too little is known about the range of radio reception in Papua New Guinea to assess whether or not the RSPP will be able to provide inexpensive, effective primary radio science instruction to the targeted rural areas of the country.*

- FINDING 15:** *That distribution costs cannot be calculated until some estimate is made on what percentage of community schools can receive the Karai services and then, conversely, what percentage will require cassette tapes.*
- FINDING 16:** *That it is still an untested assumption that rural community school boards of management will be willing and able to provide the batteries necessary for maintaining the RSPP broadcasts on a regular basis.*
- FINDING 17:** *That antennas and instructions on how to install them will be needed by many rural community schools.*
- FINDING 18:** *That there is widespread acceptance of the content and value of the RSPP materials being produced over the science materials currently being used in the system.*
- FINDING 19:** *That some of the illustrations which are easily interpreted by most people in the Central Province where the formative evaluations take place, are likely to be much more difficult to interpret for people in the more remote areas of the country.*
- FINDING 20:** *That time constraints have prevented the project from testing the radio science instruction for out-of-school youths and adults as outlined in the project proposal.*
- FINDING 21:** *That, until recently, RSPP teacher training and NDOE In-Service training were heading in different directions.*
- FINDING 22:** *That NDOE is worried that the cost of producing and maintaining work-folders or workbooks for every two science students in all 2300 community schools in Papua New Guinea is likely to be prohibitive.*
- FINDING 23:** *That NDOE is worried that it will be too expensive to provide each pair of Grade 4, 5 and 6 students in all 2300 community schools with science kit materials like those used for Grade 4 science.*
- FINDING 24:** *That there is no guarantee of learning gains in the targeted rural schools until there is reasonable assurance that the workbooks, Notes to the Teacher, kit materials, antennas and possibly cassettes actually reach these schools.*
- FINDING 25:** *That the proposed shift in focus toward teacher-directed materials may easily result in the preparation of more teacher aids than the teacher will find time to use.*
- FINDING 26:** *That further work is needed on the testing tool itself to determine why the post-test scores were not above the 50% mark.*
- FINDING 27:** *That test questions should be designed initially in the host country and then sent to Friend Dialogue in South Carolina, USA for adjusting, with follow-up fine tuning once again back in the host country.*
- FINDING 28:** *That the standard of English and exposure to Western influences is much greater in the Central Province than in any other part of the country.*
- FINDING 29:** *That the RSPP must incorporate more teacher-directed support materials before the majority of students receiving the radio science education show significant gains in learning compared to students receiving the NDOE's standard science education.*

RECOMMENDATIONS

- I. That the RSPP be extended by six months to June 1991 with an agreement that NDOE join the programme in 1991 to continue supporting the revision of materials, implementation and evaluation.
- II. That the current director retain a key role in guiding the project through to its completion via computer communications and short-term visits.
- III. That the NDOE and RSPP begin talks immediately to identify a contract officer who is a science educator with the skills required to complete the more difficult Grade 6 broadcast materials in order for him to take up duty alongside the new interim director in late 1990 or early 1991.
- IV. That RSPP provide a salary differential for the NDOE position for one contract period to ensure the completion of production, revision and summative evaluation of all the Grade 4, 5 and 6 materials.
- V. That the new interim director be appointed with responsibilities focusing on supervising the implementation of the model as adapted by the current director and on orienting the new NDOE contract officer to the model for carrying out the completion of the production, revision and summative evaluation of all the Grade 4, 5, and 6 materials.
- VI. That add-on costs be calculated as soon as possible using the model as currently adapted with revised kit materials and flip charts in lieu of worksheets.
- VII. That RSPP scriptwriters be included in interagency workshops to update their skills from time to time following the departure of the writing consultant.
- VII. That a glossary be maintained in the Grades 4, 5 and 6 *Notes for the Teacher*.
- VIII. That negotiations for solving the programme scheduling difficulties that will eventually arise on the Karai services are best left until material preparations for the national broadcasts are complete, since the rewriting and other adjustments made to school broadcasts is expected to result in a pattern of flux for broadcast scheduling.
- IX. That the RSPP develop a research model and initiate a survey to determine what percentage of rural community schools are likely to benefit from the RSPP broadcasts. The study should aim to determine which areas get an adequate daytime signal, which areas get only a nighttime signal, which schools have radios, which schools require radio antennas and which areas have difficulty obtaining batteries. (The same study may also be able to determine which schools have difficulties receiving materials. See recommendation XVI.)
- X. That technical input should be included in the regional In-Service Training Workshops planned for school broadcasts in order to provide basic information on positioning antennas in specific regions.
- XI. That in order to maximise the benefit to the students in the rural areas, provision in future planning should include further testing of the interpretation of the illustrations specifically in remote areas without road access to the towns.
- XII. That the RSPP sponsor a trial radio science programme for adults and out-of-school youths combining the infrastructure already developed for coffee rehabilitation in Papua New Guinea with the new adult literacy initiative in the Curriculum Development Division in one of the Highlands provinces.

- XIII. That the teacher training consultant continue with the new initiatives being taken to work closely with the NDOE in-service staff in developing and expanding the teacher-directed component of the RSPP, giving greater attention to layout and graphics in the presentation of the material.
- XIV. That the radio science lesson worksheets be prepared in the form of large, laminated flip charts to be made available to each school and that the A4 worksheets be offered to boards of management to purchase as they are able.
- XV. That a bare-bones science kit of minimal and easily replaceable materials be developed for schools that cannot afford the full K200 kit.
- XVI. That, along with recommendation IX, RSPP design and initiate, in conjunction with NDOE and provincial staff involved in distribution, a research project that will identify which schools are subject to distribution problems and what steps can then be taken to resolve those problems, leaving the completion of the project to the department and its related provincial divisions.
- XVII. That formative evaluations for later projects be restricted to more typically rural areas in order to match the RSPP to the levels and conditions of areas where education standards are typical of the majority.
- XVIII. That future programmes need to allocate more time to staff orientation before pre-testing is administered.
- XIX. That more teacher-directed content be camouflaged in the classroom broadcast tape, leaving one easy-to-read, teacher-preparation guide and a one broadcast tape.

APPENDIX I
EVALUATION SCOPE

RADIO SCIENCE PROJECT

May 10, 1989

To: Micael Olsson
From: Tom Tilson *Tom*
Re: EVALUATION OF THE RADIO SCIENCE PROJECT

An evaluation of the Radio Science Project is to be carried out on behalf of the Office of Education, Bureau for Science and Technology, Agency for International Development, Washington, D.C. Funding for the evaluation will be covered by EDC, contractor for the Radio Science Project.

1. Scope of Work

The major purpose of the evaluation is to assess how well the Radio Science Project is accomplishing its objectives. You should refer to the contractual documents between the EDC and AID, and the Government of Papua New Guinea and EDC. In addition, Jim Hoxeng, AID Project Officer can give guidance on the scope of work. Some of the criteria would be:

- o the degree to which the work accomplished to date and that planned for the remaining period for the project is in line with the project objectives
- o an assessment of the quality of the work
- o the extent to which the project has learned about how to teach primary school science through interactive radio instruction (IRI)
- o the training of the national staff
- o efforts towards institutionalization

You should feel free to expand and refine this list. In short, you should describe how well the project is meeting its objectives, and make recommendations on how the project can best utilize the remaining 1 1/2 years under the project contract.

International Programs
55 Chapel Street
Newton, Massachusetts 02160 USA
Cable: EDC NEW Telex: 922476

IN CONSORTIUM WITH:
Friend Dialogues, Inc.



RADIO SCIENCE PILOT PROJECT

**Box 3655
Boroko, NCD
Papua New Guinea
Tel. 24-6447 -- 21-3488
Fax 675-21-1017**



6 March 1989

Notes on Radio Science Evaluation (taken from Horeng Fax 28/02/89)

1. Radio Science Project is required to have an outside evaluation this year.
2. The evaluation scope should be "as simply as possible- maybe breaking it down by Production, Broadcast, Classroom Activities and Institutionalization or variation on it that you think makes sense."
3. Length, "I'd suggest keeping it short - say 10 -15 person days plus some writing time and ask for a straight forward, no frills report."
4. Time. No indication in Jim's fax. I would guess that this should be done within the next two months in that it will be used to determine an extension of our funding for next year.

EVALUATION QUESTION AREAS (Radio Science Project)

- Institutionalization
- Production
- Broadcast
- Curriculum Development
- School Use of Materials
- Evaluation

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BEST AVAILABLE DOCUMENT

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APPENDIX II

PROJECT AGREEMENT

MEMORANDUM OF AGREEMENT

Section One: Introduction.

This Memorandum of Agreement is entered into between the Government of Papua New Guinea, (PNG) and the Education Development Center, Inc., (EDC), 55 Chapel Street, Newton, Massachusetts 02160, U.S.A. The parties to this agreement will cooperate in the research required for developing a radio-based instruction system for science at the primary school level in Papua New Guinea. The instructional system, once developed, would be usable by other countries wishing to utilize radio to teach primary school science. The United States Agency for International Development (AID) is providing financial support to EDC for the project under Contract No. DPE-5818-C-00-4087-00. EDC has responsibilities and obligations to AID as stated in said contract. The office in AID responsible for monitoring the work done under EDC's contract is the Office of Education in the Bureau for Science and Technology, located in AID's Washington, D.C. offices. That office is hereinafter referred to as AID/Washington (S&T/ED).

Section Two: The Radio Science Project ("The Project")

(A) Description of Project.

(1) This research project, which is further described in Annex A, will consist of the design, implementation, and evaluation of a radio-based model to provide effective primary science instruction in rural schools of Papua New Guinea (PNG) at low cost. The radio science curriculum materials developed during the course of the Project are expected to be usable, with some modifications, in other countries. Specifically, and as amplified further in Annex A, the project will have these features:

(a) An integrated approach to science and applied science skills, knowledge, and attitudes will be taken within the framework of PNG science and applied skills curricula.

(b) The instructional approach, learner activities, and media will follow Instructional Systems Design (ISD) methodology, modeled after the Interactive Radio methodology developed in AID projects during the past decade.

(c) Lessons will be broadcast to students in selected schools. The lessons will be accompanied by weekly teacher broadcasts.

(d) Lessons will be accompanied by simple materials and some science equipment and will be supported by training for classroom teachers, as appropriate.

(e) An important feature of the program is the use of frequent and systematic reporting to materials developers of students' performance to provide for immediate and effective modification of the radio lessons.

(f) This system for developing primary-level science materials is expected to be cost-efficient and applicable to other countries.

- (2) The project assistance completion date is September 27, 1989. By that date the parties estimate that all services financed for the project will have been performed and all goods financed by the project will have been purchased, as contemplated in this memorandum of agreement.
- (3) EDC's ability to perform the project as set forth in Annex A through the above referenced completion date is dependent upon availability of funds from AID/Washington (S&T/ED) for this purpose and on the continuation of Contract No. DPE-5818-C-00-4087-00 through the completion date.
- (4) EDC's ability to perform the project as set forth in Annex A is dependent upon PNG contributions as set forth in Annex A.

(B) Objectives of Project.

The objectives of this research Project, to be achieved through cooperation between the Ministry of Education of PNG and its Department of Education (DOE), and EDC are to:

- (1) Conduct a science education needs assessment in order to establish a baseline defining current level of knowledge of students, science education resources, and the parameters of existing DOE curriculum guidelines.
- (2) Conduct training and development activities for materials writers, broadcasters, and formative evaluators, and others as needed. Conduct in-service training in radio applications of science teaching for primary teachers involved in the Project.
- (3) Conduct small, related studies in selected schools to learn more about how children in different learning environments develop scientific thinking skills and knowledge.

- (4) Develop up to four class levels of radio science lessons, and test their effectiveness in pilot community schools. This will include programs for teachers.
- (5) Provide cost projections for use of radio science, for national distribution in PNG.
- (6) Assess the effectiveness of radio science in reaching specified objectives, compared to the effectiveness of available alternatives.
- (7) Train a group of PNG nationals in skills needed to carry out on-going primary science radio education.
- (8) Produce a documentary film or video and other materials on the Project activity and results, to be shown to professional educators and government officials worldwide.
- (9) Disseminate information about the Project to the professional community worldwide.

Section Three: Agreement Provisions

- (A) Attached is Annex B with provisions which will apply to carrying out this Memorandum of Agreement.
- (B) It is expected that the radio science model can be applied in other countries that have educational objectives and resources similar to those of PNG. One of the major goals of the Project, if successful, is to disseminate the results as widely as possible and at the lowest possible cost so that others may duplicate or adapt the experience gained in PNG. Accordingly, AID, as the project's major funder, may duplicate and distribute, at its expense and discretion, all materials produced by the Project to any government or agency outside PNG. In similar fashion, the Government of PNG may freely make use of all classroom materials (radio scripts, broadcast tape recordings, student print materials, etc.) and training materials. All materials may be duplicated and distributed in any fashion and to any extent deemed useful by that Government.
- (C) Except as EDC shall be notified to the contrary by the Ministry of Education or other authority of the Government of PNG, DOE shall in all respects relative to this project be authorized to act as representative of the Ministry.

Section Four: The Agreement

This agreement consists of these Title Pages with the description and objectives of the Project, Annex A (An Expanded Project Description), and Annex B (Agreement Provisions).

The Government of Papua New Guinea and the Education Development Center, Inc., 55 Chapel Street, Newton, Massachusetts, mutually agree to carry out the Radio Science Project described in this Agreement in accordance with the terms of the agreement, including the two annexes attached hereto.

For the Government of
Papua New Guinea

For Education Development
Center, Inc.
55 Chapel Street
Newton, MA 02160

_____	_____
_____	_____
_____	_____
_____	_____

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APPENDIX III

CONTACTS MADE

Headmaster	Gaire Community School
Grade Five RSPP teacher	Gaire Community School
Headmaster	Hisiu Community School
Grade Four Science Teacher	Hisiu Community School
Grade Five Science Teacher	Hisiu Community School
Headmaster	Avababina Community School
Grade Five Science Teacher	Avababina Community School
Headmaster	Kuriva Community School
Grade Five Science Teacher	Kuriva Community School
Headmaster	Porebada Community School
Grade Four Science Teacher	Porebada Community School
Grade Five RSPP teacher	Roku Community School
Headmaster/Grade Four Science Teacher	St. Francis Community School
Grade Five Science Teacher	St. Francis Community School
Igo Kila, Ass. Director, Development Broadcasts	National Broadcasting Commission
Dominic Kusingi, Engineering Director	National Broadcasting Commission
Iti Didiga, School Liaison	RSPP staff member
Harold Ure, Science Educator	RSPP staff member
Paul Mungul, Production	RSPP staff member
John Kambu, Evaluation	RSPP staff member
Roland Katak, Head Evaluator	RSPP staff member
Patrick Ori, Radio Technician	RSPP staff member
Tazi Rom, Materials Development	RSPP staff member
Frank Watson, Director	RSPP staff member
Sylvia Oa, Scriptwriter	RSPP staff member
Pius Ripason, Materials Developer	RSPP staff member
Anne Kuku, Scriptwriter/Actress	RSPP staff member
Anne Watson, Writing Consultant	RSPP staff member
Sam Paulus, Studio Actor	RSPP staff member
Joyce Hill, Producer	RSPP staff member
William Penias, A/Deputy Secretary	NDOE, Central Administration
Brian Deutrom, Superintendent	NDOE, Curriculum Development
Ken Rouse, Science Officer	NDOE, Curriculum Development
Kuapena Makara, Superintendent	NDOE, Materials Unit
Hitolo Abe, Supervisor	NDOE, School Broadcasts
Jon Hughes, Editor	NDOE, Curriculum Development
David Eyrich, Coordinator	NDOE, Evaluation Unit
Hugh Frame	NDOE, Research and Evaluation
Reuben Egan, faculty	NDOE, POM In-Service College
Sheldon Weeks, Education Research	National Research Institute
Louis Kuhn, Mission Chief	U.S. AID Regional Office
Dean Welty, Deputy	American Embassy

APPENDIX IV

DOCUMENTS REVIEWED

<i>Duty Statements - National Staff</i>	Frank Watson, RSPP Director
<i>Notes On Work Plan Shift</i>	Frank Watson, RSPP Director
<i>Broadcast Policy Committee</i>	Frank Watson, RSPP Director
<i>Teacher Training Support Materials Development</i>	Frank Watson, RSPP Director
<i>Radio Science Pilot Project Timeline</i>	Frank Watson, RSPP Director
<i>Procedure for Lesson Planning to Final Script</i>	Frank Watson, RSPP Director
<i>Writing Scripts for Science Activities</i>	Joyce Hill, RSPP Producer
<i>RSPP Advisory Committee</i>	1989 Membership List
<i>Analysis of School Broadcast Survey of 1984</i>	Roland Katak RSPP Head Evaluator
<i>First Grade Four Broadcasts in the East Sepik</i>	Roland Katak RSPP Head Evaluator
<i>Producing Radio Lessons for Children</i>	Jamesine Friend - 1981 Stanford University
<i>Budget 1987-91</i>	Frank Watson - 1/89 RSPP Director
<i>Highlights: US/PNG Relations 87/88</i>	American Embassy
<i>Project Proposal: Radio Science</i>	Jean Meadowcroft - 5/84 Bureau of Science and Technology U.S. A.I.D.
<i>Proposal for the Radio Science Pilot Project submitted to the Papua New Guinea Department of Education</i>	Klaus Galda, Project Director 1985 Daniel Chaytor, Science Advisor U. S. A.I.D.
<i>Development Plan - Vol.1: Sector Policies and Strategies</i>	Department of Finance and Planning Waigani - 11/88
<i>Development Plan - Vol.2: Economic Policy and Fiscal Strategy</i>	Department of Finance and Planning Waigani - 11/88
<i>Development Plan - Vol.3: 1989 Estimates of Revenue and Expenditure</i>	Department of Finance and Planning Waigani - 11/88
<i>Development Plan - Vol.4: Public Investment Programme 1989-1993</i>	Department of Finance and Planning Waigani - 11/88
<u>NDOE DOCUMENTS:</u>	
<i>Survey on the Use of Radios for School Broadcasts in PNG</i>	Curriculum Development Division NDOE
<i>School Broadcast Survey Data Sheets</i>	Curriculum Development Division NDOE - 1983
<i>Science Syllabus for Community Schools</i>	NDOE - 1984 Papua New Guinea
<i>Science for Community Schools: Teacher's Resource Book</i>	NDOE - 1986 Curriculum Development Division
<i>Science: Teacher Guide - Grade 4</i>	NDOE - 1980 Curriculum Development Division
<i>Science: Grade 5 Teacher's Guide</i>	NDOE - 1985 Curriculum Development Division
<i>Science: Grade 6 Teacher's Guide:</i>	Curriculum Development Division

<i>Constructing Science Experiments School Broadcast Schedule - 1989</i>	NDOE Curriculum Development Division
<i>Delivery of Curriculum Materials</i>	NDOE Kuapena Makara - NDOE Superintendent Materials
<i>Listening Games: Grade Six (Broadcast) English Pupils Book</i>	NDOE - 1988
<i>Community School Public Investment Programme: Subproject: Community Schools Inservice 1989-1993</i>	Curriculum Development Division NDOE
<i>Community School Public Investment Programme: Subprojects for Curricu- lum Development and Distribution 1989-1993</i>	NDOE
<i>Public Investment Programme Submission: Support of Curriculum Materials Using Radio and Television 1990-1994</i>	NDOE - 2/89 Curriculum Development Division
<i>Departmental Directory</i>	NDOE - 1988
<i>Departmental Structure</i>	NDOE - 1988
<i>Departmental Budget: Cash Flow</i>	NDOE - 2/88
<i>A Proposed Plan for Educational Develop- ment in Papua New Guinea 1989-1993</i>	NDOE
<i>Submission for Public Investment Programme Sub-project: Community Schools In-service</i>	Staff Development Unit Port Moresby In-service College
<i>Staff Development Policy Statement</i>	NDOE - 1989
<i>National Grade Six Examination: Combined Subjects</i>	NDOE - 10/87
<i>School Broadcasts Newsletter</i>	NDOE - 11/87

CRITICAL MEMOS:

<i>Future of Radio Science</i>	Brian Deutrom to Tom Tilson and Frank Watson - 28 March 1989
<i>Radio Science Future</i>	Frank Watson to Brian Deutrom, 31 March 1989
<i>New Directions</i>	Frank Watson to Advisory Board Members - 21 April 1989

AGREEMENTS:

<i>Broadcast Agreement: Radio Science Pilot Project U.S. AID contract with the Education Development Center</i>	National Broadcasting Company & Radio Science Pilot Project-4/88 Central Operations Division - 9/84 U.S. A.I.D.
<i>Memorandum of Agreement Between the Government of Papua New Guinea & the Education Development Center</i>	U.S. A.I.D. - 3/86

REPORTS:

<i>Interim Report on the Review and Restructure of the National Broadcasting Commission</i>	National Broadcasting Commission Review Committee 5/89
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<i>Summary Report</i>	Frank Watson, RSPP Director November/December 1988
<i>Summary Report</i>	Frank Watson, RSPP Director January/February 1989
<i>Annual Report - 1987</i>	Education Development Center, Inc. Newton, Massachusetts
<i>Work Plan - Jan-Feb 1989</i>	Frank Watson, RSPP Director
<i>Radio Science Project Development Plan 1989/90</i>	Frank Watson, RSPP Director
<i>1988 East Sepik Grade 8 Summative Post-test Results</i>	Roland Katak, RSPP Head Evaluator
<i>Report on the First 1989 Visit to the East Sepik Province</i>	Roland Katak, RSPP Head Evaluator
<i>Report of the Board of Inquiry Into Broad- casting (Including Television) in Papua New Guinea</i>	K. Kalo Inquiry Chairman January, 1987
<i>Observation Report: Lesson 1</i>	Roland Katak, RSPP Head Evaluator
<i>Observation Report: Lesson 11</i>	Michael Popo - 4/88 RSPP Associate Evaluator
<i>Preliminary Report on Test 1</i>	Roland Katak, RSPP Head Evaluator

RSPP MATERIALS:**UNIT SEGMENTING:**

G4-Unit Three: Lesson 18
G4-Unit Three: Lesson 19
G4-Unit Three: Lesson 20
G4-Unit Three: Lesson 21
G4-Unit Three: Lesson 22
G4-Unit Three: Lesson 23
G4-Unit Four: Lesson 25
G4-Unit Four: Lesson 26
G4-Unit Four: Lesson 27
G4-Unit Four: Lesson 28
G4-Unit Four: Lesson 29

Materials in the Soil
How Much Air Is in the Soil
How Much Water Is in the Soil
Water Travels in Soil
Study of Soil
Measuring Soil Experiments
Growth of Plants
Stages of Plants
Measuring Plant Growth
Parts of Plants
Flowers

WORKSHEETS:

G4-Original Lesson 9
G4-Original Lesson 10
G4-RSPP Worksheets
G5-Unit Two: Lesson 9
G5-Unit Three: Lesson 16
G5-Unit Three: Lesson 17
G5-Unit Four: Lesson 29

Food Chains
Seashore Community
Lessons 1 to 60
Ways of Measuring Periods of Time
The Earth We Live On
Soil and Sand of the Earth
Life Cycle of Plants

BROADCAST SCRIPTS:

G4-Unit 1: Lesson 46
G5-Unit Two: Lesson 9

Rainbow
Measuring Longer Times

BROADCAST TAPES

G4-Lesson 409

Food Chains

G4-Lesson 410
G4-Lesson 46
G5-Lesson 9
G5-Lesson 17

Seashore Community
Light
Time
The Soil of the Earth

NOTES FOR THE TEACHER:

Grade Four Teacher's Guide
G5-Unit Three: Lesson 16
G5-Unit Three: Lesson 17

Lessons 1 to 60
Managing the Land (Earth)
Soil and Sand of the Earth

OBSERVATION SHEETS:

G5-Unit Three: Lesson 16
G5-Unit Three: Lesson 17

Managing the Land (Earth)
The Soil of the Earth

EVALUATION FORMS:

Student Data Form
Teacher Data Form
Supplementary Questionnaire
School Data Form
Grade 4 Post-test
Measurement Test
Grade Four Test One
Grade Four Test Two

Summative Schools
Summative Schools
Summative Schools
Summative Schools
Summative Schools
Formative Schools
Formative Schools
Formative Schools