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INTRODUCING TECHNOLOGICAL INNOVATIONS FOR
EDUCATION IN A DEVELOPING COUNTRY:
IMPLICATIONS FOR PLANNING

A Dissertation Presented

By

M.S. Vijay Kumar

Submitted to the Graduate School of the
University of Massachusetts in partial fulfillment
of the requirements for the degree of

DOCTOR OF EDUCATION
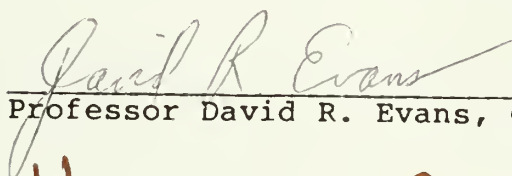
September 1986

School of Education

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ABSTRACT

INTRODUCING TECHNOLOGICAL INNOVATIONS FOR EDUCATION

IN A DEVELOPING COUNTRY--IMPLICATIONS FOR PLANNING

(September 1986)

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Ed.D., University of Massachusetts, Amherst

Directed by: Prof. David R. Evans

This study examines planning issues relating to the
introduction of technological innovations in developing
countries. Three major problem areas with respect to
planning for innovation-introduction have been identified:
a) a disproportionate "Application-Focus" as compared to an
"Organizational-Focus", that is, more concern for the
innovation characteristics than for the contextual and
people-related aspects of an innovation; b) insufficient
attention during a pilot study, to factors that could affect
the future possibilities of an innovation and c) lack of
mechanisms to detect and address probable changes required
in the technology, the users or the intervention process for
effective use of the innovation.
Literature on representative innovation projects involving
technology such as radio and television for education in

developing countries and theories and models of innovation research have been reviewed. The review of projects indicates the criticality of Organizational and Long-Term issues for the success of an innovation's installation and future. The review of innovation theories and models reflects an increase over time, in the level of synthesis of factors affecting the innovation process and in the emphasis on human and contextual aspects.

A field study was conducted in Lesotho, Southern Africa to assess the viability of using electronic learning aids to supplement literacy and numeracy education in primary schools and to identify factors affecting the introduction and future use of this innovation. Conclusions, implications and recommendations, specific to this project and for innovation planners and practitioners in general, have been presented.

The study concludes that despite the encouraging results of the exploratory study, substantial efforts on the part of the innovators, major changes in the infrastructure and intensive marshalling of resources would be required for large-scale, long-term use of the aids in Lesotho. An extensive pilot-study is recommended as an essential "first-step". For innovation planners and practitioners, the study recommends a balance between Organizational and Application perspectives, and a consideration of long-term aspects during the introductory phase.

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BACKGROUND AND INTRODUCTION

Over the last two decades we have seen the rapid
growth of modern communication technology and its
application to educational development. At first, with
newspapers, film and radio and then with computers and
satellites, modern communications technology has been used
for enhancing education in a variety of contexts and
applications. The impetus to this growth has been provided
to a large extent by educational planners, who believe that
education is the catalyst through which developmental goals
of a nation could be achieved (Klassen and Collier, 1972;
Nyerere, 1967). Table 1 indicates the magnitude of this
growth and its impact, especially in developing countries.

Instances of this trend towards using modern
communications technology for educational purposes, such as
satellite relays of educational television in India,
computer-assisted instruction and micro teaching in Spain
are numerous. This leaning towards innovative approaches in
education, especially those involving modern technology, is,
to a large extent, a result of disproportionate returns from
investments in conventional educational practices which have
been stretched to a limit. Scarcities in educational

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TABLE 1*

Mass Media Change in Low Income Countries: 1963-1973
(Units per Thousand Inhabitants)

Region	Radio Receivers	TV Receivers	Daily Newspaper Copies	Cinema Seats
Africa				
1963	32	>1	10	6
1973	54	4	14	4
Percent Change (+300%)*	+69%	+400%	+40%	-33%
Asia				
1963	12	>1	17	8
1973	41	4	20	6
Percent Change (+300%)*	+242%	+400%	+18%	-25%
Latin America				
1963	104	22	73	34
1973	171	68	62	22
Percent Change	+64%	+209%	-15%	-35%

Sources: Unesco Statistical Yearbook and World
Communications.

*The table, though quantitatively incorrect, does reflect
the increase in mass media in low income countries. The
figures in parentheses are construed to be the real
figures.

materials, have led educators to seek innovative solutions to the problem of educating the masses.

Projects involved with the application of innovations for educational development have, depending on their aims and contextual constraints, met with varying degrees of success and failure.

The Honduran Radio Santa Maria project, for example, was an illustration of a successful use of radio in providing literacy education to rural areas (White, 1976). White's study suggested that the project was not only effective in providing education to rural people where none existed but also supplemented conventional education. White's study of the Honduran Radio (White, 1977), however, found relatively little impact of radio on literacy on over one hundred thousand peasants who participated in the experiment. The project was considered insufficient in providing information that could be used in meaningful ways. It must be stressed however, that a considerable number of these evaluations were formative. The experiments were also conducted with different objectives such as, coordination, information, education and mobilization, and within different socio-political and economic environments.

It is important to note that the "success and failure" as reported in the literature, were quite dependent on the extent and quality of the evaluation that had been conducted and depended to a large extent on the objectives of the

project. Evaluations of the introduction and adoption of innovations are very limited in number and scope, probably due to: a) the time gap which occurred before realistic evaluations could be completed; b) lack of funding; or c) an assumption that a project was proceeding satisfactorily.

With the introduction of technology for educational development, the process of Educational Planning for innovation and reform has also become increasingly complex. Numerous planning approaches, such as Systemic Planning, planning involving a variety of resources and planning emphasizing the "non-rational" elements in the educational system (Levin, 1978; Carnoy, 1975) have been suggested. The point to be remembered, however, is that the practice of planning, especially for introducing an innovation in a hitherto untried environment, is at best an exercise in educated anticipation. The process involves many technical and non-technical assumptions such as:

a) the technical viability of the innovation to address the educational need for which it was intended

b) the social, political and economic conditions, of the environment in which the innovation is being introduced, and their ability to support its introduction and testing

c) the probable technical and non-technical bottlenecks and their solutions: Can the system

financially support the pilot study? Can it provide

the necessary administrative and managerial support

facilities?

d) to what degree can experiences from a prior

experiment with the innovation, if any, be extended or

extrapolated to the current environment?

e) what are the overall consequences of introducing

the innovation?

It is unavoidable that both planner and administrator
make a number of assumptions about the consequences
of their proposed actions. They are forced to rely
on a series of hypotheses or even theories of 'cause
and effect'. Both must fundamentally reason: If 'A'
is done, 'X' will follow, for example, if the size of
classes is reduced, pupil learning will improve.
. . . To illustrate, the attempt made in the
Nordrheim-Westfalen innovation to provide further
education for the employed as a means of reducing
unemployment can only achieve that purpose if jobs
are available for the (further) educated (Adams and
Chen, 1981).

An analogous assumption would be that if computers

were introduced in a developing country, literacy would be

enhanced.

However, the fact remains that the history of

technological innovations is a doleful one. Numerous

projects have been attempted, but few have been enduring

enough to provide compelling demonstrations of the scale or

quality of their anticipated impact (McAnany, 1978).

Havelock and Huberman (1977), for instance, have made the

following observations, based on their evaluation of forty

UNESCO funded projects:

Many of the educational innovations in developing
countries involve a major system transformation.
They are, typically, ambitious in the amount of
time, energy and material resources invested and in
the degree of the massive changes, expected. In spite
of such large-scale investments, few of these
innovations appear to make a major dent at the
national level in the educational or training
problems, which they were designed to solve.

Regardless of the reasons, certain inferences can be
made about the introduction of innovations and the planning
approaches associated with such introductions. These
inferences form the basis of this study.

Problem Statement

Planning approaches implicit in the numerous endeavors
for introducing educational development reflect the
following features, one or combinations of which, need to be
overcome:

1. a disproportionate Application-Focus as compared
to an Organizational-Focus. An 'Application-Focus' suggests
concern for attributes of a technology, such as its ability
to improve literacy or its interactive features and its low
cost of production.

An 'Organizational-Focus', on the other hand, relates
to aspects such as the training, the motivation, the
organizational structure, behavioral issues and the social
and political considerations associated with the use of a
technology. It entails the anticipation of questions such

as the ones stated below, their answers and the consequences
of the answers:

>   a) what impact will the innovation have on special
>   interest groups in the country where it is introduced?
>
>   b) will the teachers like it?
>
>   c) will the public react favorably?
>
>   d) will the target audience perceive it to be useful?
>
>   e) will administrators and politicians (decision
>   makers) find the innovation attractive or threatening?

2. a <u>short-term perspective</u>, whereby a pilot project
is primarily concerned with the immediate consequences of
applying an innovation to education, such as improvements in
learning and the change in attitudes, and ignores the
long-term aspects.

3. a planning approach, whereby a project at its
pilot study stage proceeds as a <u>step by step</u> process rather
than a <u>parallel process</u>, meaning that aspects of long-range
planning are not incorporated at the pilot study stage.

4. planning approaches, so far, have also overlooked
the <u>dynamic aspects</u> of introducing innovations, especially
technological ones. Technology, in its broadest sense is
not static and constantly evolves both in hardware and
software, due to research and development and more
importantly, due to the mutual interaction of the innovation
and its user. Expectations of a version of the innovation
which is more sophisticated, convenient or suitable than the

original one are quite possible. Planning approaches have not considered this aspect or included mechanisms that detect such expectations and if possible explore means to address them.

The first of the problems stated above suggests a lopsided focus that planning approaches have had on the application aspects of an innovation, rather than on its organizational or contextual aspects. While the aspects related to an 'Application-Focus' are the primary reasons for considering any technology for educational development, it is the Organizational issues which suggest the internal and external strategies for effective application of a technology.

Numerous examples bear out the significance of the organizational aspects:

a) The success of the Tanzanian Radio Campaign has been attributed, largely, to the close relationship between educational and political objectives in Tanzania, that have emerged since independence. Without the support of the TANU party at all levels, the campaign would not have reached so many people or benefited from the active interest of so many government officials (Hall, 1978).

b) The negative impact of an alien building form on the social structure in an organization of an

established school in New Zealand (Adams and Chen, 1981).

An "Organizational-Focus" implies a Macro-Perspective, wherein the contextual relevance of application aspects (Micro-Factors) is significant. For instance, low-income countries might consider radio on the basis of the relatively large impact that the experimental Radio Mathematics Program had in Nicaragua (Searle, Suppes and Friend, 1977). However, before adopting radio for this purpose, these countries must see how well this medium suits the context of their country--could they afford radio at the costs projected for Nicaragua? Would the same cost factors apply? Are appropriate facilities available? Does the complexity of the application go beyond the available, trained personnel or could such a design and content be borrowed directly and with what consequences? Would such a solution cause political problems?

It must be mentioned here that the introductions of innovations in education involve a deviation from established norms of instruction. They represent an assault on the status-quo and imply social change. The threat and role changes perceived by teachers in the USA due to the introduction of computers in schools, the fears of a possibility of the deinstitutionalization of education and the consequential resistance to the introduction of computers in schools resulting thereof, is a case in point.

Besides the changes in the instructional process, the introduction of an innovation could vastly affect other aspects of the educational system, such as administrative procedures, the physical location of the educational process and societal reaction to changes in values that the innovation could create.

> Consistently with Havelock and Huberman (1977), we regard the individuals involved in an innovation as themselves constituting a boundary-maintaining group (very likely with sub-groups, too). As a new group, in order to survive, it has to establish its own boundaries by manufacturing its own identity and establishing its own integrity. Once those boundaries are set up, however, they will have to be protected, preserved and, given the nature of innovations, probably promote it also. But, because any innovation is new, (by definition), to some extent the character of that new group will be new. Its definition of reality may well be different from that of existing groups, its patterns of behavior may well be different and its values may well be different also. Accordingly, the innovation group, to the extent that it is new, will be alien to the existing system (Adams and Chen, 1981).

Insufficient consideration of contextual aspects have often led to the borrowing of experiences from one context, and their unsuccessful application in another. The OECD (1975) recognizes this problem in relation to technology-based educational innovations. This report acknowledges that the "international transfer of learning systems involves a process, whereby, an educational practice is introduced in a cultural setting, other than that for which it was originally intended."

McAleese (1978) mentions seeing such an 'international transfer package' lying on the floor in Java: the six films were useless as the 16 mm projector was not working and the supply of electricity was unreliable.

Again, since educational technology has many varieties of applications in different environments, depending on the resources and constraints, planning for the use of the technology has to consider its appropriateness in terms of the goals to be pursued, the costs, the complexity and the social and political aspects of the context, where it is applied. The implication is that the success of the outcomes must be examined within the conditions of each situation.

Two other important, interrelated problem areas are: (a) the lack of a long-term perspective and (b) ignoring a parallel planning approach. A short-term perspective may provide partial indications of the effectiveness of the innovation. It will not, however, indicate the extent of its acceptance, adoption or endurability. For instance, ignoring the possibility of a Hawthorne effect or the deceptive success of a project due to external support in its initial stages, frequently leads planners to overlook potential, logistical and administrative obstacles. When feedback about organizational factors is not incorporated in a pilot study, the study process is affected detrimentally, in as much as it generates "unrealistic" results.

A planning approach that does not proceed as a parallel process carries a time penalty for the ultimate adoption or rejection of the innovation. It also does not provide any clues as to the extent to which implementation factors have to be scaled for adoption--neither the input factors nor the effects of a pilot study can be linearly extrapolated for the adoption of an innovation at any scale!

Logistical, administrative and political factors are the predominant factors that affect the attainment of long-term objectives of introducing an innovation (for example, raising the productivity of schools in a low income country).

The long-term objectives are, however, the ultimate reasons for innovations to be adopted.

The fourth problem that this study wishes to address is, that of planning approaches for educational innovation ignoring the dynamic aspects of the innovation process. As has been mentioned before, the dynamic aspects could result either because of the evolutionary nature of technological hardware and software or due to expectations created by the mutual interaction of the users and the innovation. This problem of assuming a static context is prevalent in other plannning environments. The implications of not considering this aspect could be numerous. For instance, users of the innovation could perceive a lack of concern and sensitivity on the part of innovators about their needs and feel that

the main purpose of the testing of the innovation with them is to use them as experimental "white mice", or be recipients of "hand me downs". The transfer of obsolete computers from IBM to India is a case in point (Nielsen, 1979).

Ignoring user expectations could also lead to a high degree of skepticism, suspicion and resentment about any innovation and the people introducing them. This could develop a tendency to reject the introduction of innovations, regardless of how well-intended they are.

The innovator too, should not ignore the chances of better technologies or adaptations to the current form of the innovation that would address the goals of the innovation more effectively. The net result of ignoring this dynamic aspect could be a severe negative influence on the entire process of innovation.

Purpose and Significance

As indicated in an evaluation of educational innovation and reform projects (UNDP/UNESCO, 1981), according to Havelock and Huberman (1980), the educational innovation problem comprises five subproblems, namely:

1) The poor understanding of the nature of the educational change process

2) The lack of proven good innovations

3) The need for effective strategies for installing innovations

4) The problem of sustaining innovations after the initial stage

5) The problem of spreading the innovation throughout the educational system

This study concerns itself with planning approaches which deal with the installation of an innovation without losing sight of the problem of sustaining the innovation after the initial stage. This study is also intended to be derivative rather than predictive. Given these specific concerns and the intention, the purpose of this study is to:

a) examine examples of introductions of technological innovations for educational development, their specific goals, the processes and the reasons for their success or failure in terms of planning parameters;

b) observe, through first-hand participation, an exploratory study of the introduction of a technological innovation;

c) gather information from the participants (i.e., researchers, teachers, pupils, administrators) in order to provide a background for planning for the future of _that_ technological innovation in _that_ context;

d) based on the above (a, b and c), attempt to arrive
at general principles, that would be useful for
future-planning and the training of planners dealing
with innovations for educational development.

Specifically, given the history of educational
innovations, the purpose of this study is to derive or
confirm if already existent, the common denominators of an
effective planning approach for introducing an innovation,
for educational development.

An examination of specific instances of introducing
innovations for educational development will provide the
study with a clearer definition of "success and failure" in
the context of those pilot studies and the commonalities in
their planning approaches. The process of first-hand
participation and observation will aid in deriving those
aspects which would be significant but which have been
ignored or given inadequate attention to, in educational
innovation projects.

As mentioned before, this researcher perceives the
organizational issues, the long-term, parallel and dynamic
planning aspects as being critical to the successful
introduction of an educational innovation. This study, it
is hoped, will provide important inputs in order to generate
effective planning principles for the introduction of
educational innovations. These principles could be useful
for future planning exercises.

The Study Process

The process through which the study attempted to achieve its purpose, comprised a review of literature and a field-based research study involving the introduction of a technology for education in a developing country.

Literature Review

The review focused on projects involving communication technology for educational development in developing countries. It examined their aims, their types and their progression. The intent was to elicit the planning parameters vis-a-vis the performance of these projects. A review of theories and models representative of innovation research over the last two decades was also conducted, in order to gain an understanding of the innovation-process.

Field-Based Research

The field-based aspect of this study formed the backbone of this research. It included a case-study of an activity undertaken by the Center for International Education, Umass Amherst, to determine the advisability of and the interest in using hand-held electronic learning aids to supplement literacy and numeracy instruction in primary schools in the Kingdom of Lesotho, Southern Africa. The field test made use of existing English language models of the "Speak and Read" and the "Speak and Math" learning aids.

The field test ran for twelve weeks between August and December 1983. Approximately five hundred children participated in the test either by using the aids or by serving as controlled subjects. The aids, provided by Texas Instruments, were used by pupils working in groups of four for one hour per day, two to five times per week during the regular classroom time for English or Arithmetic. In order to study the application issues the research examined the technical feasibility of the aids and the learning effects of their use. Technical feasibility was assessed on the basis of observations and records of the aids' mechanical performance, malfunctions, battery-life and problems associated with storage, handleability and use in classrooms. For assessing learning effects the research followed a quasi-experimental time-series design. Four classrooms used the Speak and Read: one for twelve weeks, one for eight weeks and two for four weeks. Two classrooms used the Speak and Math: one for twelve weeks and one for eight weeks. Pupils were tested for eleven weeks in English word recognition and Arithmetic.

Questions related to the organizational aspects, which were the primary concern of this study were addressed through visits to the test classrooms for general observation and structured analyses of pupil behavior.

Interviews were conducted with pupils and teachers of the test schools and officials responsible for curriculum

and educational decision making in Lesotho. The case study provided an "inside-looking out" perspective, in the sense that this researcher participated in, and observed an actual instance of introducing technology for education in a developing country.

The objectives of the field-based study were as follows:

1) Discover the circumstances leading to this exploratory study involving technology for supporting literacy and numeracy instruction in primary schools in Lesotho.

2) Observe the exploratory study, from its evolution through its progression, in order to demonstrate its easy and difficult aspects, the sources of concern, the modifications, if any, and the reasons.

3) Answer questions revolving around

    a) Issues of Application, namely the technical feasibility and the learning effects of the aids in Lesotho's primary schools.

    b) Issues of Organization, which included a contextual perspective of the application issues, the concerns, attitudes and interests of teachers, pupils and administrators.

    c) Issues of Large-Scale, Long-Term Adoption, such as the perceived changes in the innovation, classroom and overall organization and the

obstacles to be overcome for large scale,

effective use of the innovation in Lesotho.

The questions broadly were:

Questions Relating to Application:

1) Was the educational technology being used capable
of benefiting the learning situation, in this case,
supporting literacy and numeracy instruction?

2) Were the hardware and software attributes of the
technology suitable to the context in which they are
being applied?

3) Could they be made suitable?

Questions Relating to Organization:

1) What were the effects of introducing this
technology on:

    a) the pupils: their attitudes, interests and
    learning?

    b) the teachers and administrators: their
    attitudes, perceived changes in their roles,
    threats and satisfactions?

    c) the educational setting: the structure, the
    scheduling and the relationships between the
    pupils, staff and parents?

Questions Relating to Large-Scale Adoption:

1) What were the perceived obstacles in terms of
educational planning, decision-making and
implementation for the large-scale adoption of this

technology? The question involved an examination of the implications of the cost of implementation, materials and equipment, the logistics of expansion and the training of the required personnel.

2) What was the relative degree of importance associated with these obstacles?

3) What were the possible modifications, if any, of the technology or its applications, that would render it more suitable and enhance its adaptability?

4) How did and would this innovation contribute to the goals of the project?

Data Collection Methods and Data Samples

The data collection methods used in this study were on-site observation through participation in the project and interviews based on questionnaires.

Data Samples

For both application and organizational issues, the target population comprised a sample of schools, representative of the contextual variation in Lesotho. The samples were chosen in consultation with the collaborating institution. A random, proportionate, sub-sample of students, teachers and administrators was interviewed in order to derive answers to organizational questions. The selection of schools was made with the assistance of

Lesotho's Ministry of Education which maintained
computerized school-profile data, that was available at the
National Curriculum Development Center (NCDC), Lesotho. The
sample schools were part of a list of "experimental" or test
schools. School profile data was checked to assure
accessibility of the schools and their representation of
primary education in Lesotho. Participating schools were
selected to reflect a diversity of conditions found in
Lesotho's primary schools. The sampling population
comprised a private school, an urban primary school and
rural schools. The target population for organizational and
long-term adoption issues was a sample of curriculum
planners, educational administrators and ministerial
officials. The study ensured that the students, teachers
and administrators provided a diversity of backgrounds in
terms of professional preparation, teaching styles and
attitudes.

Data Collection Methods

Application Issues. Scores, obtained by the pupils
tested for English language and Arithmetic performances,
provided the data for assessing the learning effects of the
aids. Data for assessing the technical feasibility was
obtained from records maintained by teachers of the test
classes. The records were based on observations of the
teachers on battery-longevity, malfunctioning of the aids,

extent of exposure of the aids to the students and problems with other physical attributes of the aids such as voice, display and handleability.

Organizational Issues. Data for organizational issues was obtained from interviews, structured and semi-structured observations, field notes and meetings with the participants.

Interviews

Interviews based on prepared questionnaires were conducted with pupils, teachers and administrators. The interviews were conducted with assistance from the collaborating institution for purposes of translation and to preserve ethnic nuances. The questionnaires were in English and the local language, Sesotho. The questionnaire based interviews were administered to pupils from the five "experimental" schools. The students were randomly picked. The sample of teachers interviewed were representative of one hundred percent of the test school teachers. The sample for administrators was selected in such a way that they represented not only curriculum directions but also the political weighings of educational decision making in Lesotho. The intention was to interview ministerial officials, officials involved with curriculum development in Lesotho and teachers regarding their attitudes, their

apprehensions and their opinions about this particular innovation.

The process of interviews, based on questionnaires, both in the local language and in English, enabled a Qualitative-Analysis approach, whereby results were generated based on feedback from users rather than the researcher's predetermined assumptions.

Three separate questionnaires were developed by the researcher to address the problems mentioned, earlier, in the problem statement:

1) for pupils, to gain feedback on their interest in the innovation, their perception of its usefulness and its functionality

2) for teachers, to derive information on their interests and attitudes towards the innovation, their perception of the innovation's contribution to education in schools, and their opinions regarding the enhancement of the suitability of the innovation

3) for the administrators, to get information on their attitudes towards innovation for educational development, in general, and this particular one; the obstacles they perceive in the large-scale adoption of this innovation; the factors that they consider critical in making decisions about the future of this innovation

Data was also made available through spot observations in the test classes, field notes taken during site visits and informal conversations with the pupils, teachers and administrators. Information was additionally obtained from observations based on meetings with the teachers of the participating schools and educational administrators in Lesotho.

Analyses

The analysis of the data focused on an assessment of the application, organizational and long-term, large-scale adoption aspects of the learning aids.

For the application aspects, the analysis was based on data collected through observations and tests conducted on the technical feasibility and learning effects of the use of the aids in Lesotho. Analysis for the technical feasibility was based on data collected on the frequency of the aids' malfunctions, breakages, battery failures, losses due to theft and the extent of exposure in classrooms.

Learning effects were analyzed quantitatively on the basis of the quasi experimental design, described earlier. Statistical analyses of the scores obtained by the pupils, who had started using the aids at different points in time, were conducted, in order to assess the changes in performance due to use of the learning aids.

Analysis of data for organizational and long term issues was predominantly qualitative. Questions in each of the interview schedules were coded according to the factors and categories associated with the specific objectives they represented. The specific objectives for each of the respondent categories were as follows:

Pupils:

1) Gain knowledge of the extent of acceptability, product knowledge and opinions regarding the use of the learning aids.

2) Derive information on preferences regarding the innovation and the intervention process.

Teachers:

1) Obtain information from the teachers on their attitudes toward the learning aids and their opinions regarding the aids' usefulness or lack thereof.

2) Gain information on teachers' opinions of pupils' reactions to the learning aids.

3) Get their opinions and preferences regarding product characteristics and method of use.

4) Obtain their opinions regarding factors which would contribute towards more effective and extensive usage of the learning aids.

Administrators:

1) Discern their opinions and attitude towards the use of audio visual aids for educational enhancement

in general and specifically the usefulness of the
learning aids in the context of Lesotho.

2) Derive the factors and issues that they would
address to make decisions regarding extensive and
effective use of the aids.

Responses to the questions were summarized and assigned to
each of the factors and categories and subsequently to the
objectives using content analysis.

Response data was also analyzed by coding pieces of
data as to how they represented the Object, Resources,
Authority, Consensus and Linkage dimensions in order to
arrive at planning parameters to be considered for the
effective introduction of the learning aids in Lesotho.

Definitions

Innovation: Innovation, in the context of this study,
refers to "an idea, practice or object that was perceived as
new by an individual or other unit of adoption" (Rogers,
1983). In the context of this study, "innovations" refers
to a technological product that contributed to the process
of education. Also, in the context of this study,
"innovation", "technological innovation" and
"educational-technology" are used interchangeably and
represent the same entity.

Technology: "Technology", as used in this study, refers only to the hardware and software attributes of a communication medium.

Macro-Factors: Macro-factors, as they relate to this study, can be defined as factors or attributes associated with an innovation (or technology) in a realistic social situation. A macro-factor analysis, therefore, is contextual.

Micro-Factors: Micro-factors, on the other hand, are factors associated with a given medium, per se, such as the portability and interactiveness of microcomputers. Micro-factors comprise only of the context-free aspects of a technology.

Delimitations

A delimitation in this study was restricting it only to literacy and numeracy instruction in the existing primary school system in the Kingdom of Lesotho, Southern Africa. Although the overall project dealt with an "out of school" context, also, this study concerned itself only with factors relating to the "school" situation.

A second delimitation was that this study concerned itself only with specific instances of technological innovations and not the entire realm of innovation applications to education. As has been mentioned before, technology has a specific connotation in the context of this

study. There is a dearth of historical evidence of such technological innovation studies.

Limitations

Time and budgetary constraints imposed on the project restricted the sample sizes of the interviewees. Given the constraints, only five schools selected by the Ministry of Education were treated as "test schools". These schools, though not representative of the most abject conditions that face primary education in developing countries, definitely reflected the diverse conditions found in Lesotho's primary schools and the diversity present in the backgrounds, professional preparation and teaching styles of the participants.

The entire duration of the study was twelve weeks. In that period, this researcher attempted to address the importance of the "people-issues" involved with the introduction and innovation of the projects. The first-hand participation of this researcher in the project, along with the intention to elicit the opinions of a sufficiently representative sample, contributed towards consistent and integrated results.

Organization of the Study

The organization of the study followed the sequence mentioned in the study process and was as follows:

Chapter I: This chapter discusses the setting, the problem and the purpose of this study. It initially draws upon specific instances of communication technology as applied to educational development. The range, the type and extent of these applications and aspects contributing to their performance as they relate to planning are discussed.

Chapter II: This chapter, based on a survey of projects involving the application of technology to education, examines the reasons for their success or failure. It also discusses the theories and models underlying the planning approaches and the nature of their application.

Chapter III: This chapter details the procedures for the field-based research study, carried out on an innovation for enhancing literacy education in primary schools in the Kingdom of Lesotho. It includes a description of the site, the innovation, the data source selection, the researcher's role, the research instrument, the data collection methods, the analyses strategies and results of the analysis.

Chapter IV: This final chapter presents the conclusions of the entire study, including the literature review, the field study and the findings from the study. Based on the study it proposes a set of recommendations. The recommendations include some which are specific to the use of learning aids in Lesotho and others which are for

planners and practitioners involved in the process of innovation.

CHAPTER II

INNOVATION RESEARCH AND
TECHNOLOGICAL INNOVATIONS

As stated in Chapter I, the roles and expectations surrounding the applications of technological innovations for educational development have increased considerably in recent years. A brief historical perspective provides partial reasons for this increase: the post 1960 era saw developing countries faced with certain common educational problems such as a high percentage of illiteracy amongst adults, increased school enrollments as a result of growing public demand for education, an increasing rate of school dropouts, out-of-date curricula and a paucity of educational resources (Klassen and Leavitt, 1977). In order to address these problems, educational planners had to examine learning alternatives and develop innovative programs for educating diverse populations in relevant development areas, in or out of school (Coombs, 1972; LaBelle, 1975). Several innovative changes, including those in curriculum and instructional methods and materials, took place. Within the category of methods and materials, probably the most significant were innovations in technologically-based products, this due to an intent to accelerate the process of change.

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The effective impact of the use of these technologies, however, implies a well-planned and integrated introduction of these innovations into educational systems, whose throughput essentially involves a flow of ideas, knowledge, products and services amongst the various individuals and groups who constitute the system. Recognizing this increasing trend in the use of technological innovations and the essentially human aspect of educational-systems, innovation, researchers and planners have placed greater emphasis on the "non-rational" elements of planning, especially in low-income countries, where resources are scarce and problems are enormous.

Given the above direction that innovations for educational development have taken, this chapter begins with a review of the literature, identifying instances of the introduction of technological innovations, especially those involving modern communication technologies for educational development, in developing countries. The chapter then proceeds to survey certain innovation research models for introducing innovations. The chapter concludes with the description of a framework which was used as a basis for analyzing data from the field study.

Technological Innovations for Education

Technology has been used over the years for a range of educational innovation and educational reform projects. The

terms "educational innovation" and "educational reform"
primarily reflect a difference in scale. An educational
innovation is usually a specific, limited technique or
approach such as micro-teaching. The implementation of
educational innovations involve minor changes and usually
happen within the existing structure. Educational reform,
on the other hand, involves changes which are large in scale
and considered more significant (UNDP/UNESCO, 1981). Though
this study is concerned specifically with an innovation, in
selecting cases for observation no differentiation between
innovation or reform was used.

A wide range of communication technologies have been
applied for educational development: radio, television and
silica chip based products, to name a few. The cases which
were drawn upon for this study, in no way do equal justice
to all the media forms and do not represent a total survey
of technological innovations in education. This was not the
intent. The intent, as mentioned in Chapter I, was to draw
upon specific cases to demonstrate the extent of the
influence of organizational aspects on the effective
functioning of these projects.

As indicated before, there has been a substantial
increase in the use of communications media such as radio
and television in low-income countries. These technologies,
though initially developed for non-educational purposes,
were subsequently applied as a solution to some educational

problems. The application of these technologies in developed countries has followed a cyclical pattern: widespread use, due to the strong interest of educators who were strong advocates of the technology and the forceful marketing of the industry, followed by low use due to disenchantment when expectations were not met or when there was a change in the educational program, followed by renewed interest and wide application at lower levels in the school system (Gandy, 1976). Low-income countries follow the same cyclic pattern. This is evident from the transition from the earlier, widespread use of large scale trials of educational television to the current experiments to examine the use of technologies, both large and small. These technologies serve a variety of educational goals (Jamison and McAnany, 1978; Schramm, 1977; Bates and Robinson, 1977; Mayo, Hornik and McAnany, 1976). Consequently, over the last ten years a wide variety of communications technologies, such as radio, television, film, computers, cassettes and combinations of such media, have seen applications in educational development for developing countries.

Radio

The role of radio for education in developing countries assumed significance only after 1960. Though the initial applications centered around agricultural extension, subsequent uses included instruction in English language as

in Thailand and the Phillipines (Jamison and McAnany, 1978), science education as in Kenya (Ball, 1971) and health education in Tanzania (Hall and Dodds, 1974). The use of radio as a supplement for regular classroom instruction has also gained attention as in the case of the Radio Mathematics program in Nicaragua (Searle, Suppes and Friend, 1976). Research on the use of radio (Simmons, 1980) has mainly focused on the differential learning capabilities of participants using radio as compared to conventional teaching (Wilkinson, 1980). Research is also considered to be in its infant stages. However, two major points regarding the use of radio for educational development stand out:

    a) The need for extensive government support for radio to achieve its potential.

    b) The lack of careful planning and administration (Khan, 1977).

These two aspects, as well as other organizational aspects, are borne out by other radio projects such as the Tanzanian Radio Campaign and the Nicaraguan Radio Math Program.

Tanzania

Beginning in 1967, Tanzania embarked on a series of radio campaigns to help provide education and stimulate national development. The foundation of these radio-based campaigns was the Arusha Declaration of 1967 and the related

plans in which President Nyerere emphasized the importance of expanded educational opportunities as being an important determinant of democracy and egalitarianism.

The impetus on non-formal adult education, according to Hall (1975), was due to Tanzania's concern about formal schooling having become too expensive, the inaccessibility to formal education for large portions of the population and the inflexibility of the formal school system with regard to accepting innovative practices. The most popular of these radio campaigns was "Mtu ni Afya" ("Man is Health") campaign. The campaign's learning system included the activation and support of a field organization to establish local study groups, the preparation and distribution of study guides and manuals and radio for broadcast messages. The broadcast messages provided information on health. Most of the data on the impact of the "Mtu ni Afya" have been provided by Hall's 1978 study of the campaign. In the author's opinion the campaign was a great success, with the average study group participants demonstrating a 47 percent knowledge-gain score in health (Hall, 1978).

According to Hugh Barrett, the expatriate advisor during the period of the campaign, it was the flexibility, the sense of cooperation and the initiative of the leaders and staff of the coordinating organizations that was responsible for the campaign's success (Barrett, 1976). However, many political and logistical obstacles had to be

surmounted in order to get the campaigns off the ground. Interminestrial cooperation, essential for the organization of the field work and coordination of the local developmental activities, had to be ensured. This required having the support of Tanzania's political leaders, and was made possible through meetings amongst members of parliament, various ministry officials and leaders of the TANU party. Local efforts to recruit study-group leaders and explain campaign agenda was also important and was undertaken by local leaders from the TANU party, grassroots adult education organizers and volunteers.

The main problems encountered during implementation were the lack of radios, shortage of study guides due to faulty distribution, too large a group size and mainly the fact that the extent of inter-institutional coordination necessary to plan, execute and follow up, did not meet expectations.

Part of the success of Tanzania's radio project could be attributed to the fact that radio was already available in the country and therefore the capital investment that would have been necessary if a new communication technology were to be used, was very little. However, the most significant aspect of the campaign's success was the support of the TANU party at all levels, without which the campaign would not have reached so many people, would not have had the authority or legitimacy to organize people at the local

level and would not have benefited from the active support of government officials (McAnany and Mayo, 197).

Nicaragua

The Radio Mathematics Project in Nicaragua was an example of the use of radio in a formal school setting. The project, conducted by Stanford University, intended to examine the suitability of adapting the maths curriculum of a developing country to radio. Nicaragua was selected as a site because, besides having conditions such as a shortage of materials and teachers, and an ill-educated population which are common in the developing world, it had other features that were deemed suitable for the Radio-Math experiment: the fact that there was no previous in-school radio instruction in Nicaragua and hence no competition with an existing program, and secondly all the instruction could be carried out in one language, Spanish, thereby lessening potential administrative and pedagogical problems. The most important aspect of the selection of Nicaragua as a site, in terms of introducing the innovation, was the willingness of the government to lend the project support in the form of staff and facilities.

The institutional element of the project comprised a half-hour radio broadcast followed by a set of activities directed by the classroom teachers. Weekly feedback

information was provided in the form of test scores, classroom observations and teacher comments.

The project's results and trends indicated the effectiveness of the project and verified the fact that radio could be used as a medium for teaching elementary mathematics in developing countries (Searle et al., 1976).

The project team, due to their unfamiliarity with the Nicaraguan educational context, put in considerable effort in studying the potential audience as well as existing instructional procedures to determine what factors would have to be taken into account in the adaptation of Nicaragua's math curriculum for radio. This in part could also be a reason for the effectiveness of the project. Diagnostic tests were conducted to gain preliminary information regarding the participants. The results reflected two aspects which were probably specific to the Nicaraguan context:

> 1) The exercises presented orally proved to be easier than comparable exercises in written form.
>
> 2) Performances of children from urban, municipal and rural schools were surprisingly similar (Searle et al.).

A significant finding of the project was that the role of enthusiastic teachers in intervening during the learning process was found to be important, although the use of radio was initially designed to compensate for teachers'

weaknesses and the variability in terms of their math knowledge. The extent of intervention was lower in the higher grades and higher in the lower grades.

Costs, depending on assumptions of electricity expenses, were estimated to be between $0.50 and $0.75 per student in the lower grades, once the lessons were developed. Economists concluded that despite higher costs in higher grades due to a higher fall-off rate in enrollments, costs would be within the budget constraints of Nicaragua. The effect of the environment and the political situation on the longevity of an educational innovation is well exemplified by the Nicaraguan project--the pattern of growth in use in the Masoya district and outside during the first four years (1974-1978) was broken in late 1978 when schools closed due to revolutionary activities. Overall, the Nicaraguan Radio Math project was considered to be cost-effective and successful (Searle, Suppes and Friend, 1978).

In summary the survey of radio's application to educational development in developing countries highlight the following organizational and planning aspects which are critical to the effective introduction and use of the media:

1) The significance of governmental support, as is evident from both the Tanzanian and the Nicaraguan cases, where the projects could be launched because of

the support received from their respective
governments.

2) The importance of participation by all involved in
the projects. In Tanzania, for instance, the inputs
of the TANU's network of local leaders, grassroots
adult education organizers attached to various
ministries and volunteers contributed vastly in the
coordination of the local effort in terms of
recruiting study-group leaders, the provision of a
meeting place and explanation of campaign matters to
local leaders.

3) The need for the human element alongside with the
use of the media. This was borne out by the
difference made by the presence of teachers to
intervene, during radio lessons, in Nicaragua.

4) The significance of context-specific aspects:
Nicaragua, for instance, was considered suitable for
the introduction of radio because instruction through
only one language was possible and there was no
established, competing in-school radio instruction.
Additionally, the costs projected for Nicaragua were
low because of an already existing infrastructure to
support education through radio.

5) The decisive role that socio-political factors play
in the introduction and continuation of a technology:
In the case of Tanzania the political ideology of

President Nyerere and the TANU party was instrumental
in phasing-in the project and its subsequent
successful implementation. In the case of Nicaragua,
after four years of growth, schools had to be closed
due to political turmoil.

6) The importance of planning ahead--the efficient
conducting of the Nicaraguan project was in large
measure due to the preparations done by the Stanford
team in terms of studying the potential audience as
well as the instructional procedures of Nicaragua.

Television

Like radio, the use of television for educational
development in developing countries assumed significance
only after 1960. Predominant amongst the applications were
those in Niger, American Samoa, India and Columbia after
1964 and those in El Salvador and the Ivory Coast after
1969. The applications in Niger, American Samoa, El
Salvador and the Ivory Coast represent the most extensive
use of television for educational reform. All these four
projects had, more or less, similar reasons for considering
television: universal or expanded enrollments, improving
the quality of instruction and making it more suitable to
national needs. Table 2 (Shramm, 1977, pp. 135-137)
summarizes the similarities and differences in the projects.

TABLE 2

Similarities and Differences in Television Projects

	Niger	American Samoa	El Salvador	Ivory Coast
MAJOR OBJECTIVES	Expand primary enrollment, make curriculum more relevant, test ITV	Swift improvement and expansion in schools, make curriculum fit Samoan life, concentrate on mastery of English	Greatly expand enrollment in Plan Basico without loss of quality, introduce new curriculum, then turn to other parts of system	Expand enrollment in primary school, train teachers to carry load of new responsibility
OUTSIDE SUPPORT	France provided about $1.5 million capital, $600,000 annual operating	U.S. through territorial budget provided $2.5 mil. capital for TV, about $1 mil. annual operating, plus capital budget for new schools	From U.S.A.I.D. about $1 million in grant, $2 million loan; from IBRD, $4.9 mil. loan; from UNESCO, UNICEF, others, about $2 million	From France about $5 million over 5 yrs., $1 million from UNDP and UNESCO, $1 mil. from Canada, $11.2 million loan from IBRD
PREPARATION TIME	About two years	About three years	About nine years general, two years specific planning	About four years
USE OF TV	Core teaching	Core teaching	Core teaching	Core teaching
SUPPORT OF TV	Classroom materials, feedback, inservice training, ITV team, curriculum revision --latter especially noteworthy in Niger	Same	Same	Same

TABLE 2--(Continued)

Similarities and Differences in Television Projects

	Niger	American Samoa	El Salvador	Ivory Coast
PACE	One grade a year, never more than 800 pupils	12 grades in two years; reached every child in American Samoa in four years	One grade at a time; doubled enrollment in Plan Basico in 4 yrs.	One grade at a time; 20,000 pupils first year, 60,000 second year
CLASSROOM TEACHERS	Monitors	Qualified teachers	Qualified teachers	Qualified teachers
TEACHER TRAINING	Six weeks before first term; repeated second year	Emphasized inservice training	Full year of retraining for each teacher	Extensive inservice training
ORGANIZATION	Almost completely separate from Niger Ministry of Education; operated as experiment under French ITV team	Integral part of Samoa Department of Education; under U.S. educators and broadcasters at first, administration now Samoan	Integral part of Ministry of Education; used advisers, but project always in Salvadoran hands	Integral part of Ministry of Education; large number of foreign experts
TELEVISION FACILITIES	One low-power TV transmitter, well-equipped production center with three studios	Six open-circuit VHF channels, two transmitter towers on mountain, four studios, 10 VTRs	Rented time on air for four years, and got along with one studio for three years now has two transmitters of its own and building with three studios	Has building with two TV studios, one radio; national TV network provides time

TABLE 2--(Continued)

Similarities and Differences in Television Projects

	Niger	American Samoa	El Salvador	Ivory Coast
PRODUCTION	About 400 programs a year, representing about one hour a day; French, arithmetic, basic programs	6,000 programs a yr. (2,000 hours) until 1971; now about 2,200; all subjects in 12-year curriculum, plus pre-school and adult services	13 programs per grade per week; about 500 per year in 5 subjects--between 4 and 5 hours a week	7 to 8.5 hours a week: French, math, basal education

Source: Big Media, Little Media: Tools and Technologies for Instruction, Wilbur Schram, 1977.

Certain commonalities in terms of organizational parameters, which were considered germane to the effective introduction and implementation of these television projects were as follows:

a) the importance of strong support from the top. In Samoa, for instance, it was the vigorous support and backing of Governor Rex Lee which made it possible for the ITV project to be operational within four years since the idea was conceived. Again in Niger it was President Diori's interest that made the existence of the project possible. It is also significant that the lack of other strong support in the government made it difficult for the project to expand beyond the experimental stage.

b) the importance of the opinions of participants at all levels in shaping the project. The failure of the Niger project, for instance, was attributed to a large extent, to the opposition from the ministry whose curriculum and methods were rejected and who did not have control over the new classes. Additionally, the teachers union whose members were rejected in favor of untrained monitors were not in support of the project, initially. In Samoa, initial opposition primarily came from members of the Department of Education who did not believe in teaching by television. In El Salvador, too, the major opposition came from the

teachers' union which, being dissatisfied with
salaries, struck at television mainly because they
felt that the equivalent money could be used for
higher teacher salaries.

c) the necessity of support people and materials to
facilitate the use of the medium. Television, like
other media, needs teacher-guides, study materials and
teachers or facilitators. In El Salvador, for
instance, the retraining of teachers and the provision
of guides and study materials was considered
significant.

d) the need to integrate the medium into the local
culture and the local power structure. This was
accomplished in Samoa by turning over the system to
Samoan leadership. In the Ivory Coast this is being
accomplished by training of teachers to pursue the
"Ivortization" of creative and productive staff. In
Niger the integration was not done, to the detriment
of the project--teaching through television was
regarded as a "foreign" experiment.

e) the introduction of the medium entailed the
creation of new roles and a modification of old roles
of teachers and students, changes in content and
methods of teaching and learning. As reported from
the Ivory Coast experiment, the fashioning of the
educational message, which lay in the hands of the

teacher alone, was now shared with a planning and production team. The teacher also changed from his/her previous role to one of an educator working with an audio-visual aid. This necessitated the need for a system of training to take account of these new professional requirements. In many cases the use of the media, modified the traditional linear relationship between teacher and pupil to a triangular relationship between teacher, media and pupils. The use of the medium allowed a large portion of the work to be carried out in groups, encouraging the child's spontaneity and developing the spirit of inquiry (Shramm, 1971; N'Guersan Konand, June; Rogers, 1983).

Innovation Research: Theories and Models

This section of the chapter will survey various theories and models which have been the basis of innovation research and its application to innovation introduction, adoption and diffusion. The section commences with a brief discussion of the historical progression in developmental communication and concludes with a description of the framework upon which the analysis of the field study is based.

Most of the thinking and research on communication, for up until a period after the Second World War, was based on a simplistic, mechanistic view of communication as a

process of message transmission. Communication researchers were not concerned with the _human_ aspects of communication (Rogers, 1983). In both advertising and promoting technical change, which were the major areas of application of communication technology in the post-war years, the primary focus was on the _effects_ of communication. Subsequently this focus extended to developing countries where communication was considered to be a key instrument for development. The growing impetus on development and the interest in selling expensive communication equipment contributed towards making communication media an important element in the development process of developing countries. Development agencies strived to use the latest technology to carry out aggressive multimedia campaigns. As a consequence, the relevance and accuracy of content were often neglected (Bordenave, 1979). Gradually, communicators began to abandon the perception of communication as a purely mechanistic phenomena and a view of communication as a "process" evolved. This view took into account numerous variables associated with the act of communication, such as the perception the sender has of the receiver and vice-versa, the values and expectations of both the source and the receivers, the interpretation of symbols and situations and the many, varying aspects of different cultural contexts. The concept of communication as a "process" led researchers to draw upon a range of

disciplines such as anthropology, sociology, rural sociology, social psychology, political sciences and economics. The influence of these disciplines provided the process of communications with two important inputs: 1) the concept of social systems and 2) the concept of diffusion of innovations. Social systems are any interactive social structure having objectives, norms, status roles, power, social rank, sanctions, facilities and territoriality. Social systems exist through several important processes, such as communication, decision-making, boundary maintenance and socio-cultural linkage (Beegle, Loomis, 1957). The social system concept brought out the close relationship of communication to other elements and processes in a society. The ideas and research generated by the study of the diffusion of innovations primarily grew out of the perceived potential role of technology as being crucial to development (Rogers, 1983). The study of the diffusion of innovations brought attention to aspects of the innovation diffusion process such as: a) the personal antecedents favoring the adoption and diffusion of an idea; b) the social characteristics of individuals and communities influencing the adoption and diffusion of a practice; c) the behavioral changes in the receiving individual or community such as awareness, interest, evaluation, trial and decision; d) the characteristics of the innovation that enhance or decrease its adoptability such as compatibility, complexity,

communicability and divisibility; and e) the roles affecting the diffusion of an innovation within a community such as innovator, opinion leader and laggard.

The preceding discussion suggests the increasing levels of synthesis over time in the progression of developmental communication, representing both an increase in the knowledge of possibilities and potentials and the extent of humanization of earlier theories.

The process of innovation introduction, adoption and diffusion, as indicated before, is essentially part of the larger schema, namely, developmental communications. As will be evident from the discussion of various innovation research and theories that follows, the progression in innovation theory and models in terms of increasing levels of synthesis, reflects that of developmental communication.

Early research on educational innovation was fueled considerably by the pressure of interest groups such as government agencies, corporations and parents seeking accountability and demanding valid assessments of educational practices. In the 1960's the focus of this research, which was initially on assessing which educational innovations or changes were effective, shifted to assessing the process of innovation--the initiation, adoption and diffusion of an innovation. This shift in focus could be attributed primarily to the difficulties faced in assessing the effects of innovation, since most innovations had either

failed to be adopted on a large scale or had, in the process of being adopted, changed drastically from their original form (Rogers, 1962; Havelock and Huberman, 1977).

Rogers (1983) defined innovation as an "idea, practice or object that is perceived as new by an individual or other unit of adoption" (Rogers, 1983). This research was founded upon two terms relating to innovations, adoption and diffusion. According to Rogers "adoption" was the decision to make full use of an innovation whereas "diffusion" was the process by which "an innovation was communicated through certain channels over time among the members of a social system" (Rogers, 1983). Rogers approach to innovation research emphasized two significant aspects:

1) it was the perception of the adopter (or user) that qualified an idea, object or practice to be an innovation and not the presumption of the developer

2) the adoption and diffusion of an innovation occurred within a social system and the social structure of the system affected the adoption-decision process in several ways

The above aspects were reflective of the influence of anthropology, sociology and rural sociology on innovation research, wherein the influence of a society's culture, particular social groups within a culture, the characteristics of innovation adoption and communication were emphasized.

With his emphasis on the adopter and social system as guidelines, Rogers proposed four aspects of the innovation diffusion process which affected the adoption of an innovation: 1) the characteristics of the innovation; 2) adopter categories; 3) social system effects; and 4) stages of adoption.

Based on a review of 500 diffusion research studies, Rogers suggested five characteristics of innovations upon which the acceptance or rejection of an innovation were dependent (Rogers, 1983). These five categories were: 1) relative advantage, or the extent to which an innovation was perceived to be superior to others by adopters or potential adopters; 2) compatibility, or the degree to which an innovation was perceived to be consistent with the needs, existing values and past experiences of an adopter; 3) the complexity of the innovation or how difficult to understand or use was it perceived to be by the adopter; 4) trialibility, or the degree to which an innovation could be experimented with on a limited basis; and 5) observability, or the extent to which the effects of an innovation were visible to others. A related characteristic of innovations that Rogers pointed out was that they were not necessarily invariant, and hence capable of reinvention by adopters during the process of diffusion.

The above characteristics of innovations indicated that, according to Rogers, it was the adopter's perception

which defined an innovation and its characteristics. Rogers
went on to categorize adopter characteristics on the basis
of their innovativeness, which was the degree to which the
adopting individual or unit was relatively earlier in
adopting new ideas than others. The five categories
proposed by Rogers were innovators, early adopters, early
majority and laggards. Rogers presented a composite picture
of these categories in terms of their "salient values",
"personal characteristics", "communication behavior" and
"social-relationships" (Rogers, 1983).

Rogers' most important contribution to innovation
research was probably his view of the innovation adoption
and diffusion process as the "Innovation-Decision Process".
The innovation-decision process was the process that a
decision-making unit progressed "from initial knowledge of
the innovation to forming an attitude towards the
innovation, to a decision to adopt or reject, to
implementation of new ideas, and to confirmation of this
decision" (Rogers, 1983). The rationale behind the
"innovation decision process" was that adopter behavior,
both before and after adoption, was equally important in the
survival or demise of an innovation. In collaboration with
Floyd Shoemaker, Rogers conceptualized the five main steps
in the process:

　　　　1) <u>knowledge</u>, which occurred when an individual or

　　　　other decision-making unit was exposed to the

innovation's existence and gained some understanding
of how it functions;

2) persuasion, which occurred when a favorable or
unfavorable attitude was formed towards the
innovation;

3) decision, when the decision making unit(s) engaged
in activites leading to adoption or rejection of the
innovation. At this stage the innovation was
evaluated as to its anticipated consequences;

4) implementation, when the innovation is put to use;

5) confirmation, when the decision making unit sought
reinforcement of an innovation decision, with a
possibility of reversing a previous decision, if
exposed to conflicting messages about the innovation
(Rogers, 1983).

Rogers and Shoemaker also cited four other factors
that were found to influence the adoption or rejection of an
innovation. These were: 1) the type of innovation--whether
it was optional, collective or authoritative; 2) the kinds
of communication media--whether mass media or interpersonal;
3) the social system in which the innovation was
introduced--whether it was modern or traditional; and 4) the
consequences of the innovation--whether desirable or
undesirable, regardless of whether they were direct,
indirect, anticipated or unanticipated (Rogers, 1983).

Rogers also concluded that within a social system there were two prominent roles which affected diffusion: a) the opinion leaders who by virtue of their competence, social accessibility and conformity to the system norms, were capable of influencing other individuals' attitudes and behaviors; and 2) change-agents who influenced clients' innovation decisions in a direction considered desirable by the proponents of the innovation (Rogers, 1983). The concepts proposed by Rogers served as a basis for considerable amount of future research done on innovation adoption and diffusion. Of particular significance to this study were his conceptual categories of innovation, namely, innovation characteristics, adopter characteristics and social system effects.

Katz and his associates (Katz et al., 1963) defined the process of innovation diffusion as the "acceptance, over time, of an idea or practice by individuals, groups or others adopting an idea or practice, linked to specific channels of communication, to a social structure and to a given system of values or culture". This definition reflected a shift in focus from a consideration of innovation and adopter characteristics in the process of adopting an innovation to an emphasis on the social structure and value system of the receiving community. Katz drew upon the perspectives of various disciplines and synthesized them to conceptualize the innovation process and

lay grounds for further research. Katz recommended a set of research tasks to enhance innovation research: 1) a more refined definition of "acceptance"; 2) more ingenuity in looking at the relationship of time to innovation acceptance; 3) development of "content-analysis" methodologies for classifying innovations; 4) attention to the unit of adoption, be it an individual or a group; 5) an examination of the interpersonal channels of communication within a larger social structure; 6) comparative studies of instances where the same innovation was diffused in different social structures; and 7) a study of the compatibility between an innovation and the recipient culture (Katz et al., 1963). The basis of the above tasks were the elements of the diffusion process as identified by Katz. These elements were: acceptance, time, item, adopting units, channels of communication, social structure and the system of values and culture.

Miles' (1964) works were specifically concerned with theories related to innovations in education. While attributing the failure of change efforts in education to a disproportionate focus on innovation characteristics rather than on the process, Miles also pointed out certain aspects that educators and educational change agents had given insufficient attention to or even failed to address, before introducing innovations into a system. These aspects were:

1) an examination of characteristics, specific to educational systems, which significantly influence innovation efforts;

2) the underlying characteristics of an innovation;

3) the conditions prevalent in the system, prior to the introduction of the innovation which could affect the change process, detrimentally or otherwise;

4) the processes occurring in the system when an innovation is introduced;

5) the characteristics of the innovative unit;

6) the circumstances under which an innovation could be rejected by the receiving community;

7) the circumstances leading to a change in the rate of innovation at different periods of time.

As would be evident from the preceding discussions, Rogers, Katz and Miles emphasized the influence of the diffusion process on the adoption decision of an innovation. Katz and Miles, additionally, drew particular attention to the influence of channels of communication, and the characteristics of an innovation vis-a-vis the structure and the culture of the adopting social system.

The researchers whose contributions have been discussed so far focused on the adoption and diffusion of innovations, identifying variables associated with the innovation adoption and diffusion process. Their contributions were particularly significant in establishing

a non-simplistic view of the innovation process and
indicating its many complex aspects. The works of these
researchers promoted and formed the basis of many more
substantive theories and models of innovation, some of which
will be discussed in the rest of this chapter.

The Linkage Model

Based on a review of 4,000 sources, including both
theories and practical studies of innovations, Ronald G.
Havelock proposed the "linkage" model in 1971. The
"linkage" model synthesized the three theoretical categories
into which he had organized the 4,000 sources. These
categories were:

1) Research, Development and Diffusion (R, D and D)--
the R, D & D category was essentially based on a
marketing perspective whereby innovations were
considered to be "products" to be researched by
developers and then "sold" to consumers. The emphasis
was on the quality of the innovation (product) and
that of the diffusion process by which a change agent
persuaded the user (consumer) of that quality;
2) social interaction--the "social-interaction"
perspective focused on the relationships between the
various individuals that needed to be developed during
the innovation process for acceptance of the product
by the adopter(s). Relationships were formed between

the developer of the innovation and the change agent,
between the opinion leaders and the change agent and
between the opinion leaders and potential adopters,
resulting in an action-reaction situation. The
communication process was two-way, from the developer
to the user and vice-versa with the change agent and
opinion leader as intermediaries. The
"social-interaction" perspective emphasized the
inter-relationships between the individuals rather
than the quality of product (innovation) since the
product was apriori assumed to be of high quality;
3) problem solver--this perspective stressed the
importance of assessing the needs or problems of the
potential adopters and responding to these needs.
Potential adopters' needs were first assessed and the
innovation researched, developed and evaluated in
response to these needs and then delivered to the
adopter. Within the problem solver perspective,
innovation was a cyclical process in which the adopter
initiated and executed the steps of adoption, using
the change agent as a facilitator or consultant.

As mentioned earlier the "linkage-model" synthesized
the above three perspectives. Emphasis in the
"linkage-model" was placed on the links between the adopters
and their external resources, including the change agents,
developers and material resources. In this respect it used

the "problem-solver" perspective as a basis. In the
"linkage" model, both the adopter and the change agent had
collaborative roles in initiating needs assessment,
identifying resources and evaluating the innovation. The
resource person was invoked only when a situation demanded
it. The role of the resource person was that of a linking
function between the adopter and external resources in order
to seek and provide information to the adopter when the
necessity arose (Havelock, 1971).

Havelock suggested that researchers should examine the
process of innovation dissemination within the context of
its totality and not merely address part or parts of the
process. In this respect he proposed that disseminations be
examined according to "who says what to whom by what channel
to what effect" (Havelock, 1971). Simple as it seemed, this
formula for examining innovation dissemination covered all
the constituent elements of the process.

Havelock also identified factors influencing the
utilization of innovations, which were common across the
4,000 studies that he had reviewed. He categorized these
factors as: 1) linkage; 2) structure; 3) openness; 4)
capability; 5) reward; and 6) proximity and synergy
(Havelock, 1971). "Structure" referred to the way in which
various systems within the innovation process were ordered:
the developer, the change agent, the resource and adopter
systems. "Openness" referred to the amenability of a system

to change and how it related to other systems. "Capability"
was the capacity of those within the system to seek
resources and utilize them. The frequency and form of
"rewards" and the "proximity" of the innovation were
influential factors. The "synergy" factor represented the
numerous, diverse resources inherent in all the other
factors (Havelock, 1971). Havelock's work was significant
for its extensive, comprehensive and insightful treatment of
the process of innovation and dissemination of innovation
and that of factors influencing their utilization.

In the 1970s the number of studies on innovation saw
a phenomenal increase (Havelock, 1971). Many of these
studies were based on the research and theories formulated
previously by innovation researchers and included a number
of evaluations of innovative educational programs. Such
studies were instrumental in providing the field of
innovation research in providing empirical data on
innovation theories based on applications and
implementations of innovation projects. A related
development was that the number of diverse findings also
increased. A discussion of some models which were concerned
with the implementation aspects of innovations follows.

Three-Stage Model

This model proposed by Paul Berman and Milbrey
McLaughlin, originated from a Rand study of the diffusion of

293 federally-funded innovative programs sponsored by the
U.S. Office of Education (Berman and McLaughlin,
1974-1978). Berman and McLaughlin applied the theories of
previous researchers to an actual field study of innovative
projects. Their model suggested three stages in the life of
an innovation project: 1) initiation; 2) implementation;
and 3) incorporation.

At the "initiation" stage projects were planned and
decisions made by local education agency officials as to
which ones to support. During the "implementation" stage,
the project was introduced into an institutional setting and
project plans translated into practice. Berman and
McLaughlin hypothesized that "effective implementation"
required mutual adaptation between the project as planned,
and the institutional setting. During "incorporation" the
innovative project lost its "special project" status and
became part of the routinized behavior of the institutional
setting. At the implementation phase a project ". . . may
be continued in whole or part as a result of deliberate
district, decision or individual teachers with or without
formal district-support (Berman and McLaughlin, 1975).

Berman and McLaughlin also indicated three categories
of factors which they found were influential in the
implementation of their projects:

1) The innovation or project characteristics, such as
the type of innovation, the kinds of resources, the

mode of communication, the decision making process, and implementation strategies.

2) <u>The climate of the institutional setting</u>, into which the innovation was introduced. This included adopter attitudes, administrative support and the flexibility of the individuals in that setting.

3) <u>The federal policies or system demands</u>, surrounding the project. These were the federal regulations by which the projects were managed and were primarily influential in the initial stages (Berman and McLaughlin, 1975).

As is evident from the description of the three stages of the innovation process according to Berman and McLaughlin, they gave more importance than previous researchers to the behavior and other aspects of the post-adoption stage of the process. The model was therefore significant in its applicability to the study of the institutionalization of innovations.

Concern-Based Adoption Model (CBAM)

This approach to innovation research was developed by Gene Hall, Susan Loucks, Richard Wallace, A. A. George, William Dorsett, William Rutherford and others from the Research and Development Center for Teacher Education at the University of Texas at Austin. The model considered the

adopting unit (individual or groups) to be the key factor in the adoption of an innovation.

However, CBAM did use concepts from the linkage and the research, development and diffusion perspectives described earlier, in that it emphasized the relationship between the external change or resource agency and the adopter and also assumed, apriori, that the innovation was beneficial (Hall, Wallace, Dorsett, 1973). CBAM focused on adopter concerns and adopter behaviors. Francis Fuller (1969) who was the major contributor to the study of adopter concerns hypothesized three categories of adopter concerns: 1) concerns about self; 2) concerns about task; and 3) concerns about impact (Fuller, 1974; Hall et al., 1973). These three categories were expanded into seven "stages of concern" and field tested as to their reliability and validity. These seven "stages of concern" were:

1) Awareness--At this stage "little concern about or involvement with the innovation is indicated".

2) Information--"A general awareness of the innovation and interest in learning more detail about it is indicated. The person seems to be unworried about himself/herself in relation to innovation. She/he is interested in substantive aspects of the innovation . . . such as general characteristics, effects and requirements for use."

3) <u>Personal</u>--"Individual is uncertain about the demands of the innovation, his/her inadequacy to meet those demands and his/her role in relation to the reward structure of the organization, decision-making and consideration of potential conflicts with existing structures or personal commitment. Financial or status implications of the program for self and colleagues may also be reflected."

4) <u>Management</u>--"Attention is focused on the processes and tasks of using the innovation and the best use of information and resources. Issues related to efficiency, organizing, managing, scheduling and time demands are utmost."

5) <u>Consequence</u>--". . . the focus is on the relevance of the innovation for students, evaluation of student outcomes, including performance and competencies, and changes needed to increase student-outcomes."

6) <u>Collaboration</u>--"The focus is on coordination and cooperation with others regarding use of the innovation."

7) <u>Refocusing</u>--"The focus is on exploration of more universal benefits from the innovation, including the possibility of major changes or replacement with a more powerful alternative. Individual has definite ideas about alternatives to the proposed or existing

form of the innovations (Hall, George and Rutherford, 1979).

The CBAM researchers also proposed eight "Levels of Use": non-use, orientation, preparation, mechanical use, routine, refinement, integration and renewal (Hall, Rutherford and Newlove, 1975). Hall et al. suggested that an adopter's "Level of Use" progressed comparably with his/her "stages of concern". A definition of the eight levels can be found in Table 3 (Loucks, Newlove and Hall, 1978, p. 8).

According to CBAM, the beliefs and actions of adopters were of primary importance and systems must respond to them rather than stand isolated or insensitively control them. The CBAM's adopter center approach was stressed by Hall (1979) when he stated that the adoption of an innovation by an entire institution depended solely on the summative actions and concerns of adopters. The CBAM provided useful inputs to this study in terms of providing guidelines for the field based aspect of the study in the design of instruments and analysis.

The Political Model and The Adaptive Model

Both these models were proposed by Jack Lindquist (1978, 1979) and emphasized the role of the change agent and strategies that should be adopted by change agents. According to the "Political" approach power was the

TABLE 3

Definitions of Levels of Use

| LEVEL 0 NON-USE | State of use in which the user has little or no knowledge of the innovation, no involvement with the innovation, and is doing nothing toward becoming involved. |

LEVEL 0
NON-USE — State of use in which the user has little or no knowledge of the innovation, no involvement with the innovation, and is doing nothing toward becoming involved.

LEVEL 1
ORIENTATION — State in which the user has acquired or is acquiring information about the innovation and/or has explored or is exploring its value orientation and its demands upon the user and user system.

LEVEL 2
PREPARATION — State in which the user is preparing for the first use of the innovation.

LEVEL 3
MECHANICAL USE — State in which the user focuses most effort on the short-term day-to-day use of the innovation with little time for reflection. Changes in use are made more to meet user demands than client needs. The user is primarily engaged in a step-wise attempt to master the tasks required to use the innovation, often resulting in disjointed or superficial use.

LEVEL 4A
ROUTINE — Use of the innovation is stabilized. Few if any changes are being made in ongoing use. Little preparation or thought is being given to improving innovation use or its consequences.

LEVEL 4B
REFINEMENT — State in which the user varies the use of the innovation to increase the impact on clients within the immediate sphere of influence. Variations are based on knowledge of both short-term and long-term consequences.

LEVEL 5
INTEGRATION — State in which the user is combining own efforts to use the innovation with related activities of colleagues to achieve a collective impact on clients within their common sphere of influence.

TABLE 3--Continued

LEVEL 6   State in which the user re-evaluates the
  RENEWAL   quality of use of the innovation, deems
                 major modifications of or alternatives to
                 present innovation to realize increased
                 effect on clients, examines new
                 developments in the field, and explores new
                 goals for self and the system.

Source: Loucks, Newlove and Hall, 1975, p. 5)

motivating influence for change (Lindquist, 1978).
Lindquist suggested that the success of an innovation
process was often determined by the extent of ownership of
the process, as perceived by the adopters. The change
agent's role was therefore that of a mediator or a
facilitator of change, who involved the adopters in all
aspects of the innovation process, including needs
assessment, evaluation, selection implementation and
adoption of the innovation.

Lindquist also proposed the "Adaptive" model, which
was a synthesis of his political approach and the theories
proposed by Havelock, Berman and McLaughlin. The premise of
this model was Lindquist's theory that adopters adapt rather
than adopt existing innovations. Planned change, according
to Lindquist, was guided by the adaption of external
innovations rather than the invention of new ones
(Lindquist, 1978).

On the basis of this "adaptive" approach Lindquist,
along with Havelock, proposed strategies for the change
agent to follow through the entire process of innovation
(Lindquist, 1979). Lindquist's contribution to innovation
research, given his focus on the role of power and the role
of the change agent, were significant, especially in the
context of developing countries where the innovation process
was affected by conflicts between tradition and change and
different cultural values.

The preceding sections of this chapter have attempted to review various prominent theories and models of innovation. The models represent, both in terms of their numbers and diversity, the substantial efforts made towards understanding and modeling the innovation process and consequently enriching the process of educational innovations. Despite these efforts, educational innovation projects have seen few successes (mainly in basic and vocational education) and few innovation efforts have ever achieved their intended or promised impact.

In 1975, Ronald G. Havelock and Michael Huberman conducted an extensive analysis of the records and case study reports of a number of innovative projects in developing countries in an "attempt to seek explanatory factors and derive hypotheses regarding processes of educational change and their probable outcomes" (Havelock and Huberman, 1978). Based on this analysis and its subsequent refinement they proposed a framework comprising specific dimensions to aid in the understanding of reasons for an innovative project's extent of success or failure. In the authors' opinion these six dimensions could be used for both planning and prediction of a project's outcomes (Havelock and Huberman, 1980).

The framework proposed by Havelock and Huberman served as a basis for the analysis in the field based aspect of

this study and is discussed in the remaining part of this chapter.

ORACLE Times Four: Predicting the Generalization of Innovation

Havelock and Huberman (1980) maintained that the problem of educational innovation comprised a series of five subproblems, each of which could contribute to disappointing results in an innovative project. These five subproblems were:

1) the poor understanding of the nature of the educational change process;

2) the lack of proven good innovation;

3) the need for effective strategies for installing innovations;

4) the problem of sustaining innovations after the initial stage;

5) the problem of spreading the innovation throughout the educational system.

The first two subproblems, which involved the content of the innovation rather than the process, were categorized by the authors as the "problem of innovation". The last three subproblems were categorized as the "problem of generalization" (Havelock and Huberman, 1980). The first subproblem of generalization revolved around the selection of a strategy to transform a conception of change into reality in a real setting, that is, introducing the

innovation. Strategy issues include the choice of location, the timing of the introduction, the speed of implementation, the scope of initial implementation and the degree of participation and consensus that were required from interested parties (UNDP, UNESCO, 1981). The second subproblem of generalization involved the progression of the innovation from a trial effort to continued long-term acceptance and integration into the routine of the educational system. The potentially problematic aspects associated with this progression were the possibility of non-replicable aspects of the trial effort and the non-availability of resources on the scale required for the spread of the innovation. The third aspect of generalization involved the diffusion of an innovation from one setting to the larger system. Having articulated these aspects of the "Problem of Generalization" of innovations, Havelock and Huberman, on the basis of the findings of their 1975-1976 studies, went on to identify four patterns or strategies of introducing and sustaining change, and six themes or dimensions which seemed to explain much of the phenomena. The four "model" patterns were as follows:

1) The Crusade, which involved large scale revolutionary change in all sectors of society and at a national level, such as a national literacy campaign;

2) <u>Radical Change</u> or the <u>Alternative to Grandeur</u>,
which took place in a carefully planned manner with
considerable assistance from external agencies during
the planning and implementation stages. The scope and
speed of such projects was relatively rapid and the
changes were fully supported by national leaders at
the highest level;

3) Controlled Expansion, where the goals for change
were more modest, the speed more restrained than in
radical change and the strategy chosen was more likely
to be in the form of adding new elements to an
existing system. Controlled expansion was more likely
to be chosen in educational systems which were stable,
where the level of discontent with the existing system
was low and where small modifications were expected to
solve problems;

4) <u>Small Local Projects</u>, which promoted change at a
relatively slow pace, relied on local resources to
some extent and in some cases went courts to
government policies. The projects tended to originate
outside the government and were modest in scale
(UNDP/UNESCO, 1981).

The six themes proposed by Havelock and Huberman to be
used for planning and predicting the outcomes of innovations
were: 1) <u>O</u>bject; 2) <u>R</u>esources; 3) <u>A</u>uthority; 4) <u>C</u>onsensus;
5) <u>L</u>inkage; and 6) <u>E</u>nvironment. For mnemonic convenience,

the composite framework was referred by the acronym ORACLE.
A discussion of each of the themes follows:

O: "Object"--a concept which included both the
substance of the proposed change and the objective or intent
of the change effort. The object dimension was broken down
into five sub-dimensions, all of which related to the
characteristics of the innovation as they facilitated or
impeded acceptance by the receiving culture. These five
dimensions were:

1) relevance--Relevance referred to the relation of
the innovation to the needs of the receiving culture.
"Need" represented either local interests or an
outsider's perception based on experience elsewhere;

2) promised benefit--This referred to the magnitude of
impact that the object had on improving upon the
status quo in the receiving culture;

3) resource demand--The extent to which the innovation
required the mobilization of scarce, external or local
resources. High Technology projects, for instance,
typically relied on external assistance in the form of
experts, equipment and funding and, in many cases, there
was a tendency to underestimate the resource
requirements or overestimate the receiving culture's
capacity. Massive and disruptive resource allocations
led to a tendency to withdrawal after the initial
enthusiasm for the innovation faded;

4) <u>complexity</u>--This could be intrinsic complexity, social complexity or the complexity of implementation associated with the innovation. Intrinsic complexity referred to the number and complexity of the behaviors for which change was sought. It also included the number of elements that had to be interrelated, such as printed materials, audio-visual aids and teacher manuals. The greater the intrinsic complexity of an innovation, the less likely was the possibility of its continued use. Social complexity referred to the number of different levels and sectors of the society which were directly affected by the innovation. For instance, a national literacy program involved the educational, business and industrial sectors as well as many layers of government. Socially-complex innovations required greater consensus and endorsement from authority for survival. Complexity of implementation referred to the extent of difficulty in the innovation's installation, demonstration and use;

5) <u>compatibility</u>--Referred to the extent of congruence of the innovation with attributes of the receiving culture such as its social and cultural values. Incompatibility arose from a clash with existing local values <u>or</u> the pre-existance of competing institution roles and practices in the receiving culture <u>or</u> the

introduction of an innovation at the wrong time, regardless of its merits.

R: Resources--Resources included financial, material, human and knowledge resources, required to introduce and sustain the innovation. Success was associated with the appropriate combination of all types of resources and their timely availability and utilization and not on their surplus.

A: Authority--Authority included both legal support and leadership of officials at local, district and national levels. "Authority" was especially critical for complex innovations. Senior level leadership was crucial at critical decision stages such as when adoption and diffusion were being considered or when there was a crisis. On a regular basis, implementation depended on stable and reliable leadership at the local project level.

C: Consensus--Consensus referred to the extent to which participation and understanding was achieved at all levels of personnel involved in the innovation. Agreement amongst the members had to be on the objectives and procedures of implementation including the acceptance of role modifications and shifts in powers, influence, responsibilities and rewards. Consensus required negotiations and some degree of power equalization to be effective. Failure to seek or maintain consensus was

associated with less extensive implementation and problems of sustaining the innovation.

L: Linkage--Linkage involved the interconnections between the various components of the educational system and its supporting services and was largely synonymous with the human and organizational infrastructure needed for an innovation. Linkage included not only the concept of connectedness but also the quality and complexity of interconnections. A clear relationship was found to exist between the magnitude of an innovation and the existence of a stable, differentiated and articulated configuration of people, roles and routines available and mobilized to serve components of an innovation. The "linkage" concept had three vital components: 1) the number of interconnections; 2) the "patterns" of the "routines"; and 3) social structure.

The number of interconnections determined the path of communication as well as the speed of communication between elements. The "patterns" or the "routines" were the ways and sequences in which the elements were connected. Social structure implied the differentiation of roles to stabilize and maintain effective problem solving routines. Good linkage implied the presence of at least four components: a) correct definition of needs; b) correct analysis of the problem; c) solution that was appropriate and possible, both materially and politically; and d) the implementation that

was rapid and reliable. The weaker the linkage the greater
was the possibility of errors and unpredictable events in
the life of a project. For instance, very ambitious
innovations when introduced into underdeveloped or
unreliable infrastructure led to a lot of unanticipated and
unpleasant outcomes. Weak linkage manifested itself at
various stages of the innovation process:

- At the need analysis stage, if real needs were not
sensed or were distorted by the time they reached the
planning and decision making stages;

- At the problem definition stage if the baseline data
was unreliable or if the educational leadership
ignored evidence from the field;

- At the solution phase, if the solution was
inappropriate or impractical;

- In the implementation phase if the people involved
in the project, the administrative and technical
machinery did not provide the requisite elements in
the form needed.

Projects introduced into weak linkage situations ended
up either as "pilot projects" securing entirely due to
special resources and unusual administrative support or in
a format that represented no change from the previous
situation.

Linkage was considered by the authors to be most
critical of the six dimensions and included many practical

components of connectedness such as distance, transport communications and coherence of the system.

E: Environment--Environment included the dominant features of the setting in which the reform took place. Dominant features affecting the fate of the innovation directly included the receptiveness to innovation ("openness"), consonance of the "object" with the local settings ("compatibility"), timing of the innovation in relation to local cycles and the larger society and the general degree of turbulence in the overall society (Havelock and Huberman, 1980; UNDP/UNESCO, 1981).

Havelock and Huberman listed some of the typical barriers encountered in their innovative projects. These are presented below.

Havelock and Huberman (1981) also proposed a theory of innovation generalization derived from ORACLE, incorporated within a general systems framework and including a temporal dimension (Havelock and Huberman, 1981). A description of the theory is presented below.

A Theory of Innovation Generalization

The theory started with the premise that the change effort was itself a system in the same sense that the receiving culture and its various components were systems. A change effort could therefore be construed as a complex inter-system exchange between the "change-effort system" and

the "receiving system". This collision of the two systems resulted in any of the following outcomes:

- destruction of either the change system or the receiving system or both;

- mutual withdrawal without alteration;

- fundamental (systemic) change in either or both;

- superficial or temporary change in either or both system (Havelock and Huberman, 1981).

Innovation generalization, according to Havelock and Huberman, was "both a problem of communication and a problem of transformation" (Havelock and Huberman, 1981). It would be perceived as a sequence of stages, which began with the transformation of a concept or "objective" into programmatic reality, perhaps initially on a small scale and a limited period of time (initial implementation or the pilot stage). If this initial implementation was successful, there were two possible problems at the next point in time: one was the "continuation" problem or the problem of maintaining the innovation at an adequate performance level in succeeding time period at the same site (first stage of generalization); the other was the diffusion problem or the problem of achieving equivalent adoption in many more sites or in the society as a whole (second stage of generalization).

The next stage of generalization involved the continuation and integration of the diffused innovation into

the larger culture and the consequent transformation of that culture into a system which functioned at a higher level than before. The ORACLE themes were represented to different extents in the time-transfer and transformation process at each of these three stages of generalization and the success of each stage was dependent on the consideration of these themes. For instance, at the first stage, successful continuation could require a reformulation or adaption of the reform's original configuration (O); it could require a renewed marshalling of resources or resources of a different kind (R); it required a firm commitment on the part of leadership, either to allow continued existence or specially sanction it (A); crucial at this stage was the support of various interest groups affected by the reform (C); it required the establishment and the reinforcement of linkages with authority figures and to others who had continuing responsibility or were contributing special skills to the reform effort (L); finally, environmental turbulence in the host culture, at this stage could lead to key staff being drawn away to other causes (E).

At the second stage of generalization (diffusion) the ORACLE considerations were: the intrinsic suitability of the reform for widespread adoption, the inherent communicability, its resource demand characteristics and its compatibility with norms, values and established practices

of the receiving culture, as a whole (O); the resources
required to transform and package the innovation for
transportability and to provide resources, financial and
knowledge, for start up at new sites with costs being borne
locally to a larger extent than in the previous stage (R);
the clear and publicized commitment to the project from
authority figures (A); a larger, more complex degree of
consensus among a more diverse set of recipients than the
previous stages (C); a higher degree of social integration
and leadership (L); and a stable, relatively flexible
environment (E). At the third generalization stage, also,
when system wide integration and routinization occurred, the
consideration of the six themes was critical. ORACLE
considerations at this stage were similar to the
"continuation" stage in content but higher in magnitude as
the entire receiving culture was considered at this stage
(Havelock and Huberman, 1981).

In summary, Havelock and Huberman proposed a theory of
innovation generalization based on the premise that reform
was an inter-system phenomena comprising a series of time
transfer segments. These segments could be viewed as a
series of stages which moved the reform from an abstract
concept to successively extensive and integrated levels of
realization in a recipient culture. Finally, each of these
stages could be analyzed and understood in terms of the
interactive effects of six dimensions or themes: object,

resources, authority, consensus, linkage and environment. Careful consideration of these dimensions at each stage was critical to the successful outcome of reform efforts.

CHAPTER III

THE FIELD-BASED RESEARCH

As was mentioned in Chapter I, one of the prime
concerns of this study was to observe, through first hand
participation, an exploratory study of the introduction of
a technological innovation. The intent was to arrive at
certain general planning principles for introducing
technological innovations for educational development in a
developing context. This field study was designed to gather
information from the participants in order to provide a
background for planning for the future of an innovation used
in contexts where it was introduced and to indicate the
significance of the organizational issues.

This chapter details the procedures of the field-based
study. It includes a description of the site, the
innovation, the data sources' selection, the researcher's
role, the research instruments, the data collection methods
and analysis strategies.

Choice of Site

The site chosen for the field-based study was the
Kingdom of Lesotho, Southern Africa. Because of an
extensive system of primary schools, Lesotho has one of the
highest rates of literacy in Africa. There are about 1,000

primary schools in Lesotho with an enrollment of approximately 270,000 children. The primary school curriculum consists of the local language--Sesotho, English, Mathematics, Social-Studies, Science/Health and practical studies, which are taught for 45 minutes each, daily. The expenditure for the education provided is borne both by the government and parents of the pupils.

There is a wide variation among schools with respect to fees, enrollments and facilitites. School profile data has been presented in Appendix A.

There is a commonly shared concern about the quality of education in Lesotho, especially regarding English language and numeracy education. A report published by the Educational Sector Survey Task Force in 1982 had this to say:

> Particularly distressing were the standards in English and Mathematics, the two subjects on which selection for further education hinges . . . they had been so badly taught that much of the time in Form A was spent on reteaching them the foundations of the language . . . there was suspicion that modern math encouraged teachers to neglect the basic skills of numeracy and accuracy. The result was that simple arithmetic skills could not be performed confidently by the majority of pupils (1, p. 10 Report).

Primary schools in Lesotho also face the problem of a high pupil to teacher ratio (48:1). The choice of Lesotho as a site was practical because support arrangements by the collaborating institutions, i.e., the Lesotho Distance Teaching Center (LDTC) and the National Curriculum

Development Center (NCDC), Lesotho, were expected to be favorable, given the Center for International Education (CIE) which initiated the project, had had previous collaborative venture experiences with them. The choice of Lesotho as a site for the field-based research, involving experimentation with technology for education was suitable.

Choice of Innovation

It has been noted that developing countries have had to give greater consideration to alternative approaches and innovative changes on the process of delivering education. The increased importance and closer scrutiny given to the application of technology to education, has been a significant component of this quest for innovative approaches. As mentioned earlier, the use of radio and television has been considered promising for primary schools in developing countries. Microprocessor driven learning aids, whose feasibility for primary education in developing countries had not hitherto been addressed, were considered for this study.

The field test made use of two electronic aids made by Texas Instruments, Inc., the Speak and Read[TM] and the Speak and Math[TM]. These aids, which weigh just over one pound, can be hand held, use a three-chip system and are comprised

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[TM]Speak and Read and Speak and Math are trademarks of Texas Instruments, Inc.

of a synthetic speech system, an eight-digit alpha/numeric display and a keyboard. They can provide drill and practice in English and Arithmetic.

The Speak and Read provides practice in phonics, visual vocabulary and reading comprehension, using 250 basic English words.

The Speak and Math offers arithmetic drills at three levels of difficulty, providing up to 100,000 randomly generated, different problems.

The choice of these learning aids as the innovation for empirical testing in the exploratory study in Lesotho was considered appropriate for the following reasons:

1) They provided drill and practice which is considered essential for the acquisition of basic skills.

2) The aids provided immediate, individual feedback, both audio and visual, which was difficult otherwise, in large size classes.

3) The aids were considered to be enjoyable to use as indicated in preliminary testing.

4) The aids, if used in groups and rotated amongst schools in Lesotho could possibly provide interactive drills for arithmetic and reading at low costs (Anzalone, McLaughlin, 1984)).

Overall, therefore, the selection of the aids as the innovation was dictated by their potential to provide a

cost-effective supplement to literacy and numeracy education in Lesotho.

Data Samples, Subjects and Sources

The primary concern that influenced the selection of samples was that they should reflect a diversity of conditions found in Lesotho's primary schools. The sample of schools selected was not representative of the most abject conditions such as overcrowding and a high rate of teacher absenteeism, normally prevalent in schools in developing countries. However, given the time and resource constraints of the project, the problem of insufficient representativeness of the sample was adequately addressed by the research team. The limitations of time and resources added to the fact that this study was the first of its kind, necessitated that only five test schools be selected for the study.

Four of the five schools were part of the NCDC list of co-operating as "Experimental" schools. Computerized school profile data on all the five schools were available at the NCDC. The nomination of the five schools was made in consultation with the NCDC and the approval of the Ministry of Education, Lesotho. The final sample of five schools varied along the following primary dimensions:

1) setting--location and environment;

2) facilitites--space, furniture, utilities;

3) performance--pass rates.

The schools also varied in terms of proprietorship and fees. Summarized data about the test schools are provided in Appendix A. The sample of five schools comprised two urban schools, two rural schools and one school located in a small town or a non-suburban area.

The two urban schools, Iketsetseng and Hoohlo Primary School, were both located in Maseru, the capital of Lesotho. Iketsetseng operated privately, had excellent facilities and is considered to be one of the best schools in the country. The other Maseru school, Hoohlo Primary, operated by the Anglican Church, also enjoys a good reputation. This school, representative of a typical urban primary school, had average facilities and was crowded. The two rural schools, Masapong and O. B. Collins, were situated about forty five miles from Maseru. Masapong, operated by the Anglican Church, had average facilities, inadequate furniture and small class sizes. O. B. Collins, operated by the African Methodist Church, had average facilities and small class sizes as well. The fifth school, Morija Primary, is based in a small town south of Maseru. This school, operated by the Lesotho Evangelical Church, has average facilities and is moderately crowded.

Participating Classes

A considerable amount of discussion took place in order to decide the appropriate grade levels at which the learning aids should be introduced. The project team's initial proposal to consider Standard III was felt to be too low a grade level. Preliminary testing with a sample of pupils using the aids suggested that Standard VI would be appropriate for testing the math aids and Standard IV for testing the language aids. On consultation, the principals, head teachers and the teachers of these grades approved of this choice of grade-levels. Midway in the course of the experiment, a Standard III class from O. B. Collins was also added as a language group.

The children in Standard VI were in the age range of 11-13 years, Standard IV in the range of 9-11 years and Standard III in the range of 8-10 years.

Participating Subjects for Data Collection

The subjects for data collection comprised students and teachers from the participating schools and classes and administrators from the collaborating institutions. The size and composition of the subject samples depended on the specific research issues which this study intended to address, namely, the issues relating to application, organization and long term adoption of the innovation.

Subject Samples and Sources for Application Issues

Central to the application issues was the assessment of the capability of the learning aids to benefit the learning situation as a supplement to normal classroom instruction, and their technical feasibility in the context of Lesotho.

A total of 509 students from the designated grade levels (Standards III, IV and VI) of the test schools participated in the testing of learning effects, either by using the aids or serving as control subjects.

Ninety-two (92) pupils (42 from Standard VI in Morija and 50 from Standard VI in Iketsetseng) used the math aids. For the language treatment, the population comprised 157 pupils--29 pupils from Standard IV in Masapong, 53 from Hoohlo, 31 and 44 pupils from Standard IV and III, of O. B. Collins respectively. The language control group was made up of 134 pupils in three different streams of Standard IV at Iketsetseng Primary School. Pupils from Standard VI, Hoohlo, and Standard IV, Masapong, also shared the use of the aids, although they were not test classes. This was done in order to quelch any feelings on the part of these students that the researchers or teachers were showing partiality to specific groups. Details of the test population of students are included in Appendix A.

Teachers of the test classes were the primary source of data regarding the technical feasibility of the aids.

Data on pupil attendance, duration of use, frequency of battery changes, malfunctions in the aids, safety and storage problems were provided on computerized rosters distributed to the teachers every week. Information on the students' adaptation to the aids, problems and challenges and the teachers' activities during the time the pupils used the aids was made available from logs, that the teachers were asked to maintain.

Other sources of information were informal conversations with teachers and general observations by the research team, which served as a context for putting the hard data in perspective.

Subject Samples for Organizational Issues

Addressing the organizational issues, which was the primary concern of this research study, involved an inquiry into the attitudes and interests of the participating teachers, pupils and administrators towards the learning aids. It also involved gaining information on the effects of the aids on the education setting: the structure and scheduling, pupils, staff and parents interrelationships.

Pupils: A random sample, which represented approximately 10% of each class which used the learning aids, was selected from all but one of the five test schools. At this school, O. B. Collins, the commencement of the use of the aids coincided with the departure of this

researcher. Further, the aids at O. B. Collins were used only for a total of four weeks, during which time they were moved from Standard IV to Standard III. It was felt that it would be unrealistic to expect qualitatively sound feedback from participants in this school, due to the relatively low exposure to the aids, that they had had.

In all, twenty three pupils were interviewed. Coincidentally, though the selection was done randomly, the sample had approximately an equal number of boys and girls. The above sample of pupils served as respondents for the interviews.

Additionally, spot observations were conducted to assess pupil behaviors during the use of the aids. The sample for these observations comprised two pupils from each class using the aids, who were of the opposite sex and seated close to one another.

Teachers: A sample of six participating teachers was chosen. This sample represented 100 percent of the teachers of the participating classes, test and control, with the exception of one school. Teachers of this school, O. B. Collins, were not used as subjects for reasons mentioned earlier. The sample of participating teachers were reflective of their diversity of backgrounds and teaching styles. Details about the backgrounds of the teachers are also presented in Appendix A.

Administrators: The primary criteria in the selection
of the sample of educational administrators was to have a
diversity of opinions, which represented curricular and
educational decision-making considerations. Interviews were
conducted with seven educational administrators: a Research
Officer and an advisor from the math curriculum division of
the NCDC; a Research Officer from the English curriculum
division; the Deputy Director of the NCDC and the Director
of the LDTC; the Chief Education Officer and the Technical
Advisors for Planning of the Ministry of Education.

Subject Sample for Large Scale Adoption Issues

Interviews were also conducted to gather information
on the planning, decision making and implementation aspects
related to the potential large scale adoption of the aids as
supplements for primary education in Lesotho. The choice of
administrators, including the curriculum officers was a
natural target sample for addressing large scale adoption
issues, considering their predominant influence in
innovation adoption decision (Havelock and Huberman,
1977).

However, since teachers of the test classes were at
the actual-users level and in a position to directly use and
observe the impact of the aids in the learning situation, it
was considered that their inputs regarding the large-scale
adoption issues would also be of significance.

Consequently, target subjects for inquiry into the large scale issues comprised a sample of both teachers and administrators.

Researcher's Role

The role of this researcher was a combination of two overlapping roles--that of a participant and of an observer. The role was a variation of the "observer as participant" role described by M. Q. Patton (1980) and Norman Denzin (1970). Depending on the extent of membership and overtness adopted by a researcher during the data collection process, they described four roles: complete participant, participant and observer, observer as participant and complete observer. The variation in the "observer as participant" role assumed by this researcher was due to the extended connotation of "participant". In the context of this study, "participants" included not only the pupils, teachers and administrators, but also the researchers, consultants and the support persons from the parent and collaborating institutions. Within this extended definition of a participant, this researcher, as a member of the project team of the larger exploratory study, participated in the testing for learning effects, technical feasibility and the human-use effects of the learning aids. This researcher's role also drew upon ethnographic methods wherein the researcher derived, through unobtrusive

observation, the organizational factors influencing the reactions of the users of an innovation (Mulhauser, 1975; Wilson, 1977). These organizational factors were critical to the understanding and a realistic interpretation of user responses regarding their concerns about the innovation.

As an observer, this researcher attended to the primary focus of this study, which was to observe an actual instance of the introduction of a technological innovation for educational development in a developing country, in order to address the significance of organizational issues and derive the implications for planning for such endeavors.

The advantage of the twin role of participant and observer assumed by this researcher was that it allowed an "inside-looking-out" perspective on the process of introducing innovations, in general and this particular one.

Data Collection Methods

The research emphasis of the overall exploratory study project and this specific research study dictated the modes by which data was generated and collected. The emphasis of the exploratory study was to determine the feasibility of using existing models of electronic aids for enhancing literacy and numeracy education in primary schools in a developing country like Lesotho.

The particular emphasis of this researcher's study was to address issues of organization and long term adoption as

they related to the innovation. Overall, the data
collection methods were designed to answer questions
revolving around issues of application, organization and
long term adoption, as described in Chapter I.

Data Collection for Application Issues

At the outset, it must be mentioned that this
researcher participated mainly in the field testing, data
collection and analysis aspects for the application issues.
The design of the overall study, the experimental design for
testing application issues and analysis reflect the
contributions of the entire project team, principally those
of David Evans, David Kinsey, Stephen Anzalone, Stephen
Mclaughlin and the consultants--Mike Royer from the
University of Massachusetts, Sylvia Scribner of the City
University of New York and David Wagner of the University of
Pennsylvania. The application issues essentially concern
evaluating the technical feasibility and the learning
effects of the aids applied in the context of Lesotho.

Since these issues did not constitute the major focus
of this study, the associated data collection methods will
be discussed, only summarily, herein.

Technical Feasibility

Data on the technical feasibility was collected along
the following dimensions:

1) longevity of batteries;

2) durability of the aids under normal conditions for use in Lesotho;

3) safety of the aids in the schools;

4) adaptability to the synthetic voice and the visual display screen in the aids; and

5) extent of exposure possible for the users.

Data was gathered from different sources to evaluate the performance of the aids against the above dimensions. Computerized rosters were distributed weekly to teachers of the test classes. Records of pupil attendance, duration of use of the aids, battery changes and malfunctions in the aids. Teachers were also asked to keep logs of their observations on how well students adapted to the aids, what special problems or challenges posed to the students and them and what they, the teachers, did while the aids were in use. Information was also collected through general observation and informal conversations with teachers and school managers.

The information provided by each of the schools, on the frequency and total number of battery changes during the period of use provided data on the longevity of the batteries. Records of aid malfunction or breakage yielded data on their durability under classroom conditions in Lesotho. Loss or theft of the devices was also monitored during the researcher's visits to the sites.

Information regarding problems related to the voice, volume level and visual display of the aids was mainly subjective. To some extent information was provided implicitly by the learning effects testing. Direct evidence, however, comprised only of observation of pupils and from statements made by teacher and pupils.

The prescribed minimum amount of time for the aids to be used was an hour and one-half to two hours a week. This minimum was prescribed so that, in case there was a lack of significant learning effect, it would be clear whether it should be attributed to the failure of the learning aid or a non-existent treatment effect. Records were kept by the teachers to indicate the level of use.

Learning Effects

The evaluation of learning effects focused on the evaluation of the abilities of the aids, i.e., the Speak and Read^{TM} and Speak and Math^{TM}, to improve a pupil's performance in recognizing English words and in solving problems in basic arithmetic operations, respectively.

Data for evaluating learning effects was obtained from a series of tests, for English and Arithmetic, that were conducted with the participating classes.

Four classes using the Speak and Read, one for twelve weeks, one for eight weeks and two for four weeks, and one class not using the aids, were tested weekly on English word

recognition. Two classes used the Speak and Math: one for twelve weeks and one for eight weeks. These classes and a class that had the opportunity of using the language aid but not the arithmetic aid were tested weekly on Arithmetic.

The pattern of treatment and conducting tests was based on a "quasi-experimental" design, which was a variant of a time-series design. This design called for the aids to be introduced to the test groups at different points in time. In Arithmetic, one group used the aids for the twelve-week period the experiment was in progress. A second group used the learning aids only during the last eight weeks of the experiment. A third group did not use the math aids at all but did use the language aids throughout the experiment. In language, one group used the aids for the entire twelve-week period, a second group used them for eight weeks, a third and fourth group used them for four weeks and a final group did not use them at all.

The design was based on the logic of plausibility rather than that of certainty. The implication was that the improvement of test performances at the point where pupils began to use the aids would be indicative of evidence for the positive impact of the learning aids. Any other explanation would be extremely implausible (Anzalone, McLaughlin, 1984).

True experimental design, wherein subjects, who are alike in every other aspect, except that they do not receive

the treatment, have been a realistic approach to pursue in Lesotho, given that the intact groups for control and treatment are quite different in critical ways.

Data for English Language

Data for English Language testing was obtained from 20 minute weekly tests that the pupils took on English word recognition. Each test contained 50 items, comprising words that were contained in the instructional set of the aids and words that were not contained in the instructional set. The test words were dictated initially by a Mesotho research assistant and subsequently by the class teacher.

Data for Arithmetic

Data for testing Arithmetic performance was obtained from 15 minute tests every week. The tests contained 32 items comprising the four basic arithmetic operations, using one, two or three digits.

Data Collection Instruments for Organizational Issues

Data collection for organizational issues primarily involved three questionnaire based interviews which were conducted with the participants. Data collected through these interviews were supplemented by information gathered from on-site observations and meetings with teachers and administrators.

Questionnaires for Interviews

The design of the questionnaires, in terms of their theoretical basis, was influenced by numerous innovation studies, notably those of Havelock and Huberman, Huberman and Miles (1982), Hall et al. (1973, 1977, 1979), and Francis Fuller (1969, 1974). Huberman and Miles (1982) in their field study of innovations which were in different stages of adoption in twelve school settings, identified certain research emphases. These research emphases were:

1) The characteristics or properties of the innovation;

2) The context of the school as a social organization;

3) The adoption decision;

4) Site dynamics during continuing cycles of transformation;

5) New configuration, ultimate outcomes; and

6) Role of external and internal assistance.

Each of these emphases had sub questions associated with them which served as a guideline for interviews, observations and analysis of data. Given these emphases they collected date on six variables:

. Salient features of the innovation striking users and administrators.

. Initial "size-up" of the innovation by users and administrators, in terms of its strengths, weaknesses, probable implementation, problems, etc.

. Perceived changes anticipated in implementing the
innovation at the class room level.

. Perceived changes anticipated at the organizational
level.

. Overall goodness of organizational fit as informed
by researchers from administrators' assessments
(Huberman and Miles, 1982).

The questionnaire developed by the Concern Based
Adoption Model (CBAM) researchers and Hall et al. (1973) was
designed to elicit responses from teachers as to their
concerns regarding a particular innovation. This 35 item
questionnaire comprised short statements of concern to be
rated on a Likert scale by the respondents as to their
truthfulness for them (Hall et al., 1973). A sample copy of
the questionnaire is included in Appendix (B).

Several considerations, however, necessitated the
development of questionnaires, which preserved the essence
of the studies and instruments that they were based on, but
differed from them in form and content. These
considerations essentially were:

1) The limited duration of the project (12 weeks) and
of this researcher's on-site presence.
Questionnaires, therefore, had to be formulated in a
way as to get as much in-depth information as possible
in the limited time available. The intent was also to

keep the disruption of the day-to-day schedules of the respondents to a minimum.

2) Questions had to be in a form that was easily translatable into the local language, Sesotho, in order that the ethnic nuances of the responses were preserved.

3) Rather than merely obtaining categorical responses, the intent was to tap the more subtle aspects of opinions. Consequently, questions framed had to allow for a considerable amount of elaboration.

4) The inquiry into organizational and long term issues had to serve many functions: provide a contextual framework in order to have a more comprehensive interpretation of the learning effects, provide information on the dynamics of use, attitudes and opinions of the respondents regarding current and future use and parameters affecting decision making for large scale, long term adoption. The questionnaire, therefore, had to be formulated in a way as to probe all these aspects, to the extent possible. Again, given the limitations of time and resources, it was not possible to address each of these issues separately. A composite questionnaire dealing simultaneously with more than one aspect had to be developed.

5) Given the nature of the inquiry, responses had to be elicited from three target audiences, the teachers, pupils and administrators, the nature of whose participation in the study varied considerably. It was, therefore, necessary to develop three separate questionnaires--one for each category of respondents.

Based on the aforementioned sources and this study's research agenda a preliminary set of questions for each of the three questionnaires was formulated. The questionnaires in their final form evolved through a process of refinement and additions to this preliminary set, from first-hand on-site observations of the introductory process and informal conversations with the participants.

The questionnaires were designed to provide documentary, descriptive and contextual information bearing on the following factors of interest to this study:

1) The effects of introducing this innovation on:

a) the pupils: their attitudes, interests and learning;

b) the teachers and administrators: their attitudes and opinions, perceived changes in their roles, threats and satisfactions;

c) the educational setting: the structure, the scheduling and the relationship between the pupils, staff and parents.

2) The perceived obstacles in terms of educational planning, decision making and implementation for the large-scale adoption of this technology. This entailed an examination of the implication of the costs of implementation, the availability of material and human resources, the logistics of expansion, the training of the required personnel and the resources for evaluation.

3) The relative degree of importance associated with these obstacles in the opinion of the participants.

4) The possible modifications, if any, in the innovation, its use and the organizational context that would enhance its suitability and adoptability.

5) The contribution of the innovation to the overall goals of the project.

The questionnaires, in effect, were designed to gather information on the six variables as suggested by Huberman and Miles (1980), mentioned earlier. Additionally, depending on the category of respondents (teachers, pupils or administrators), they included certain other specific inquiries regarding anticipated, probable consequences that could impede the successful introduction of use of aids in a developing country. These probable consequences were:

. Participants' perception of the learning aids as being inappropriate to the local culture and

instruction offered by the aids as being irrelevant
or inconsequential.

. Dwindling interest in using the aids, over time, on
the part of the pupils.

. Factors such as the dynamics of use (e.g., group vs
individual) and logistics of the immediate
environment (e.g., size and physical arrangement of
the class) affecting the practicality of using the
aids.

. Detraction from the traditional teaching of other
subjects due to the use of the aids for English and
Arithmetic.

. Drastic and unacceptable alteration of pupil-teacher
relationships.

. Negative attitudes, in general, towards the
potential of innovations in addressing the
educational problems of developing countries.

Sample copies of the questionnaires may be found in
Appendix (C).

Interviews were conducted with pupils, teachers and
administrators. All the interviews were recorded.
Interviews with the pupils and teachers were conducted with
assistance from the staff from the collaborating institution
for translation of the questionnaire into Sesotho and
interpretation of the responses.

Interviews with teachers and pupils were not
exclusively on a one-to-one basis, in most instances, in the
sense that though interviews were conducted with one subject
at a time, other subjects were present. Though this process
of interviewing was not originally intended by this
researcher it was deemed both pratical and suitable because
it kept the teachers' and pupils' time-away-from-class to a
minimum. There were two significant advantages to this
approach as perceived by this researcher:

    1) Given that interviews were conducted predominantly
during class breaks and after school, this approach
ensured that the inconvenience caused to the
respondents was as little as possible.

    2) The mutual interaction and communication of the
respondents, it was felt, contributed significantly in
strengthening the quality of the responses, in that,
the process of discussion facilitated the
consolidation and concretization of the respondents'
opinions.

    3) A degree of confidence in clarifying opinions and
expressing them to a "relative stranger" in the
company of a colleague or co-participant.

This researcher noted that in spite of the constant
interaction among the respondents, there was no obvious
"band-wagon" effect and perceived opinions and
justifications expressed were individualistic.

Observations

Two kinds of observations were conducted in the course of the exploratory study, namely, general unstructured observations and structured spot observations. The observations focused on the following aspects of significance to the study:

1) The teaching/learning dynamics of using the aids in the classroom. This included an observation of pupil and teacher behaviors while the aids were being used.

2) The reaction of teachers, pupils and administrators to their experience with the learning aids.

3) The concerns of the participants in regard to the exploratory study process, current and future use of the learning aids.

Spot Observations

Spot observations initially consisted of a randomly chosen two-minute period of the use of the aids during which as many as possible of the behaviors and statements were recorded. A structured instrument, to obtain more precise data about the frequencies of observed behaviors, was then designed, based on insights drawn from the initial observations. Data on the frequency of behaviors was important in assessing if pupils were engaged in the learning task and if they had equal opportunities to operate the aids in the learning groups.

Four categories of behaviors that addressed the above concerns formed the basis of the observation instrument: engaged, not-engaged, disruptive and transition. Engaged and not-engaged behaviors indicated pupil attention or non-attention to the learning aids. The disruptive category included non-attending behavior that interfered with others in a group and the transitional category covered legitimate interruptions of activity. The four categories were broken down into specific behaviors to be observed. Two pupils, who were of the opposite sex and seated close to one another, were randomly chosen in five of the experimental classes. Observations were made for four weeks on their behavioral and emotional tone, which were sampled every minute for ten minutes. A ten minute observation period seemed sufficient to provide a representative sample of individual behavior. One minute observation intervals allowed for a reasonable compromise between the need for sensitivity to behavioral fluctuations and a manageable pace of recording behavior (Anzalone, McLaughlin).

A sample copy of the coding form with the categories and specific behaviors and their definitions is included in Appendix E. Assistance to the project team in designing the instrument and in analyzing the results was provided by Dr. Greg Davenport of the Institute of Extra-Mural Studies of the National University of Lesotho. This researcher

participated mainly in the observation and data collection
process.

General Observations

General observations were conducted in various
settings, employing different methods. Informal
conversations with the participants in classrooms and
offices and observations of on-site use were conducted.
These observations which were typically unstructured, though
there were specific items looked for, resulted in field
notes. These field notes formed the basis for information
which helped corroborate the findings from the spot
observations and the responses to the interviews.

Observations made during meetings conducted with
teachers and administrators also proved to be a rich source
of information. The process of meeting with all the
participating teachers and administrators at one time was
considered to be highly suitable in the context of Lesotho,
given its similarity to the "Pitso" which is the collective
decision making process in that country. The process of
meeting served three useful functions:

1) It provided a forum for teachers and administrators
to discuss, amongst themselves and with the
researcher, their concerns regarding organizational
and curricular aspects of the current and future use
of the aids.

2) It made a considerable degree of clarification regarding the use of the aids and the introductory process possible.

3) The nature of the encounter in the meeting, where all the participating teachers and administrators were together and the communication process was not on a one-on-one basis as in the interviews, allowed many latent (dormant) opinions and concerns to surface. These opinions and concerns included those regarding material support, training, replacements of the aids and the reprogrammability of the aids to suit curricular modifications.

In summary, the observations, besides providing corroborative information, were indicative of several aspects of concern on the part of the participants. They also proved to be a useful source of insights into the participants' opinions and attitudes regarding the learning aids and the exploratory study process.

Data Analysis for Application Issues and Results

Application issues, as mentioned in Chapter I, are fundamental to the consideration of an innovation's application in any context. The innovation needs to perform with consistency, reliability, durability, cost-effectiveness and safety. In the case of an innovation for education, it should be possible to identify at least

some of the learning effects resulting from the innovation's use in the context of its application. The analysis of the application issues related to the use of learning aids in Lesotho involved an assessment of their technical feasibility and the learning effects associated with them.

Technical feasibility was assessed on the basis of the analysis of data collected along the dimensions mentioned earlier, in this chapter. A summary of the analysis of these dimensions is presented below.

Longevity of Batteries

The longevity of batteries was an important dimension of technical feasibility both in terms of the inconvenience and expense that could result from short battery life and hence frequent replacements. Longevity of batteries was analyzed on the basis of their rate of consumption at each of the test schools during the test period. The rate of consumption was arrived at from the total consumption values which were calculated by adding the number of batteries changed to the number originally in the aids. Battery consumption information is presented in Table 4. As indicated in Table 4 the average number of hours per battery was 16.9 hours which was above the 15 hour estimate of the manufacturer. It must be pointed out, however, that calculations of the number of batteries were not entirely accurate since the aids were used by some "non-experimental"

TABLE 4

Batteries Consumed

School	Number of Aids	Total Number of Batteries Used	Total Number of Weeks Used	Average Hours per Battery
Hoohlo IV (VI)*	17	132	12	16.6
Iketsetseng VI	13	72	12	12.2
Masapong IV (VI)*	8	48	8	15.7
Morija VI	11	44	8	21.4
OB Collins III & IV	10	40	5	18.6
Totals	59	336	--	16.9

Source: Electronic Aids in a Developing Country, Center for
International Education, University of Massachusetts,
Amherst.

*The classes within the parentheses are non-experimental classes that
used the learning aids. This additional consumption of the batteries
has not been included in the figures in this table.

classes for which no record of the total time of use was maintained.

Durability

Durability of the learning aids was an important consideration, given the potentially harsh condition of use such as dust, handling and storage factors in Lesotho. Durability was assessed on the basis of records of malfunctioning or breakages, maintained by the teachers. The incidence of malfunctioning and breakage was considered to be low as only 3 out of the 62 learning aids put to use had to be replaced, in spite of some having been dropped.

Safety

Safety of the aids in the schools was indicated by the numbers lost or stolen during the period of the experiment. None of the aids were lost or stolen. While this could be construed as being indicative of a high level of safety, it was not certain whether the safekeeping was due to the regular visits of the researchers to the schools or due to the vigilance of the teachers.

Adaptibility to the Synthetic Voice and Visual Display

No tests were made to evaluate the extent to which pupils found difficulty with the voice, volume level or visual display of the aids. However, assessment of this aspect was made from observations and from the responses of

the 23 pupils and six teachers sampled to queries regarding
this aspect. The questions regarding the voice and tone and
the corresponding responses of pupils were as follows:

- Can you understand the pronunciation of the aids
  when they speak to you?

  Yes: 21   No: 2

- Can you hear the aids without difficulty when using
  it in the classroom?

  Yes: 16   No: 2

- Is understanding the pronunciation better now than
  in the beginning?

  Yes: 21   No: 2

For the teachers the questions and corresponding
responses were:

- Do you feel that the children adjusted easily to the
  machines?

  Yes: 6   No: 0

- Do you think that the accent in the machine is a
  problem?

  Yes: 5   No: 1

- Do you think understanding the accent is better now
  than in the beginning?

  Yes: 5   No: 1

As is evident from the above responses the tone and
voice (accent) of the aids did not pose any problems to the
majority of pupils. Continued experience also improved

their adaptability to the aids. Observations of the aids during their use indicated that the visual display also did not pose any major problems. In fact, the visual display was frequently used to verify the audio output of the aids. Many pupils recommended that the tone of the aids' voice be made higher. However, raising the volume level of the aids would require a trade off with the need for a moderate level of background noise. Pupils and teachers, almost unanimously, indicated a preference for a more intelligible and "human-sounding" voice.

Extent of Exposure to the Aids

Records were maintained by the teachers on the duration of use weekly. This data is presented in Table 5. As the data indicates the average amount of use in most cases, though differing among schools, exceeded the recommended time of hours in all cases. One and one-half hours was considered sufficient exposure to produce a noticeable effect on learning.

The extent of use prescribed may not have been sufficient to obtain effects that might be visible only with more intensive or long term exposure. However, the extent of exposure was sufficient to ensure the existence of a treatment effect.

Learning effects were evaluated by analyzing data obtained from a series of tests, conducted with the

TABLE 5

Amount of Time Learning Aids Were Used

School	Total Number of Hours Used in Test Class	Average Number of Hours Per Week
Hoohlo IV (VI)*	36 hours, 35 minutes	3 hours
Iketsetseng VI	14 hours, 35 minutes	1 hour, 20 minutes
Masapong IV (VI)*	12 hours, 35 minutes	1 hour, 30 minutes
Morija VI	15 hours, 40 minutes	2 hours
OB Collins III + IV	12 hours, 25 minutes	2 hours, 30 minutes

Source: Electronic Aids in a Developing Country, Center for International Education, University of Massachusetts, Amherst.

*Classes within parentheses were not test classes but did share with test classes in the use of the learning aids.

participating classes, for English, word recognition and Arithmetic performance. As was mentioned earlier in this chapter, given the circumstances in Lesotho, a decision was made to use a "quasi experimental" design to test the hypothesis that the learning aids would positively affect the English reading and Arithmetic performances of the pupils using them.

English

In the case of English language the indicators of positive effect were: a) a positive difference between scores on instructed words and scores on non-instructed words; b) a greater improvement of scores on instructed words for groups using the aids and no difference for the control group; c) greater improvement of scores on instructed words taking place after introduction of the aids; and d) a possible greater improvement on non-instructed words by groups using the aids than achieved by the control group which would be indicative of transfer of learning. The weekly improvement of each group in terms of their standardized scores are presented in Appendix E. The standardized score was obtained by dividing the difference between an initial score and the score on each succeeding test by the standard deviation of the initial scores' distribution. The initial score was obtained as the average of Test 1 and Test 2 in order to compensate for the

possibility that the gains made in Test 2 as compared to Test 1 were not as a result of pupils not understanding the test. The approximated graphs for each school are presented in Appendix F. The weekly gains, in terms of averaged standard deviation units, for groups using the aids as compared to those not using it are presented in Table 6 and through approximated graphs in Figure 1.

The data and the related graphs suggested an improvement in English word recognition as indicated by the following characteristics: a) a greater difference between scores on instructed and non-instructed words for groups using the aids and vice-versa for the control group; b) greater improvement of scores on instructed words for groups using the aids than that of the control group; and c) greater improvement of scores on non-instructed words for groups using the aids, suggesting transfer of learning. The average gains made by each group before and after the introduction of the learning aids are presented in Figure 2. An analysis of covariance on the final scores, namely, the scores of Test 10 and 11 for both instructed and non-instructed words in order to determine how much of the variation in final scores was due to the effects of the experimental treatment (see Table 7). The variation, after removing the effects of the covariate-initial test scores, was found to be significant at the .001 level, implying a positive impact of the learning aids on English word

TABLE 6

Weekly Improvement of Test Scores
of Groups Using the Language Aids
Compared to Groups Not Using the Aids

Test	Instructed	Non-Instructed
	Groups Using Aids	
2	.27	.24
3	.53	.68
4	.33	.48
5	.93	.32
6	.13	.48
7	.70	.03
8	.49	.87
9	1.44	1.16
10	1.56	.83
11	1.58	1.31
	Groups Not Using Aids	
2	.95	.62
3	.87	1.00
4	.41	.45
5	.50	.31
6	-.21	.93
7	.39	-.51
8	.51	.73
9	.30	.58
10	--	- 11
.42	.54	

Source: <u>Electronic Aids in a Developing Country</u>, Center
for International Education, University of
Massachusetts, Amherst.

FIGURE 1

Weekly Improvement of   Scores of
Groups Using the Language   Aids Compared
to Groups Not Using Aids
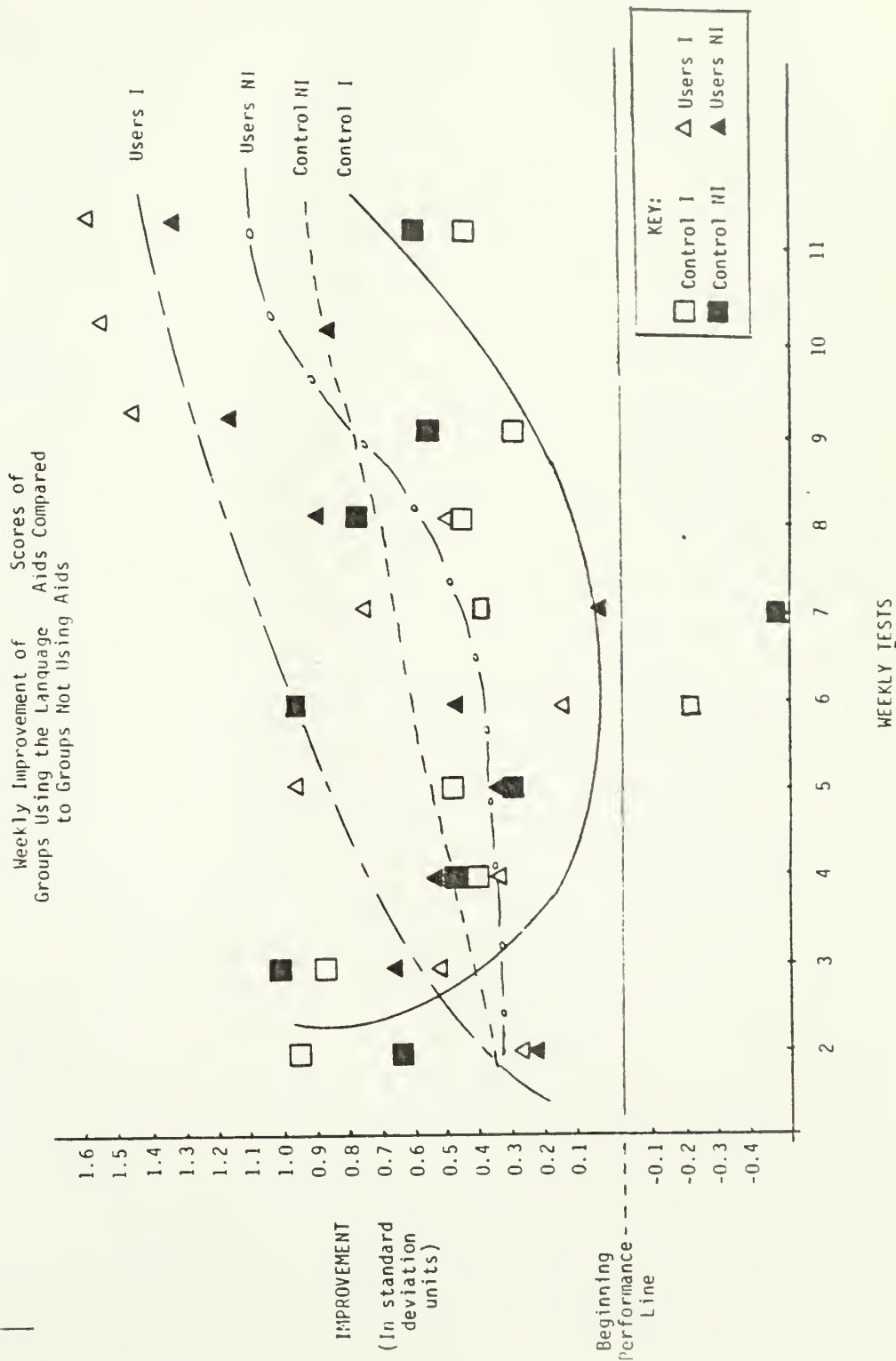
Average Weekly Improvement in Language Scores Before and After
Introduction of Aids

FIGURE 2

TABLE 7

Analysis of Covariance
Final Score (Dependent) With Group (Treatment)

Source of Variation	Sum of Squares	DF	Mean Square	F	Significance
Instructed Words					
Covariate Initial Score	943.199	1	943.199	132.085	.001
Main Effects Group	330.818	3	110.273	15.442	.001
Explained	1274.016	4	318.504	44.603	.001
Residual	1670.961	234	7.141		
Total	1944.977	238	12.374		
Non-Instructed Words					
Covariate Initial Score	1112.970	1	1112.970	170.401	.001
Main Effects Group	63.898	3	21.299	3.261	.022
Explained	1176.868	4	294.217	45.046	.001
Residual	1528.370	234	6.521		
Total	2705.238	238	11.367		

Source: Electronic Aids in a Developing Country, Center for
International Education, University of Massachusetts,
Amherst.

recognition. Test results based on analysis of variance also indicated that there were no differences between the performance of boys and girls.

An analysis of the differential effects of the learning aids, on the more or less able pupils was also made, based on the basis of their respective improvements in instructed and non-instructed words. These are presented in Figures 3A and 3B. Pupils whose scores were above the initial score were considered to be more able and those with below the indicated initial score were considered to be less able. As indicated in Figure 2, though there was greater improvement in instructed words than on non-instructed words for both groups, the learning aids had a greater impact on the less able pupils. The data from Figures 3A and 3B also confirmed that the improvement in scores was not due to practice in taking tests and that the superior performance of classes using the aids was not due to ceiling effects.

Arithmetic

In the case of Arithmetic, the indicators to determine if the learning aids contributed positively to improved abilities were: a) greater improvement across the eleven tests for pupils using the aids than for those not using them; and b) greater improvement of scores after the introduction of aids than prior to it. The weekly improvement for each class in terms of standardized scores

Improvement of Scores on instructed Words of Less Able Pupils
Compared to More Able Pupils

FIGURE 3A
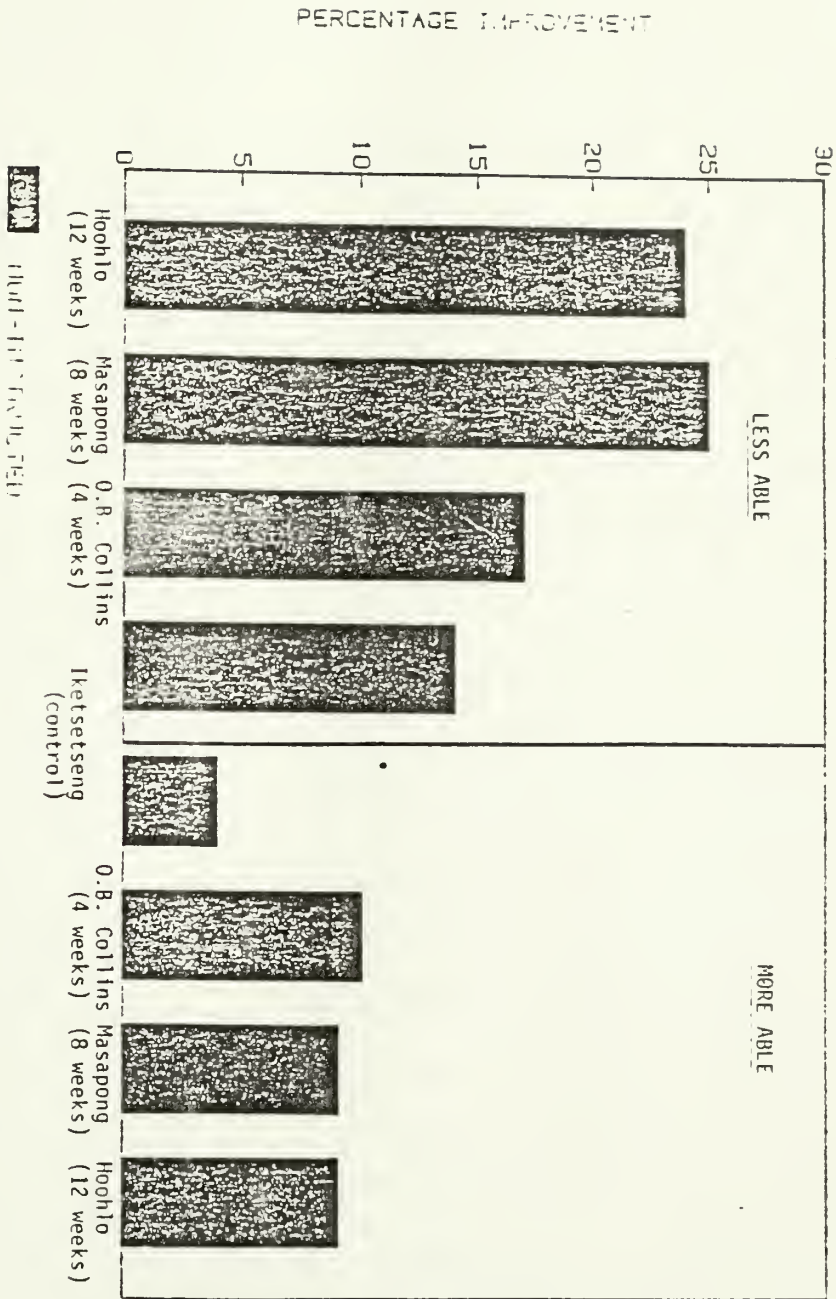
Improvement of Scores on Non-Instructed Words of Less Able Pupils
Compared to More Able Pupils

FIGURE 3B

and their corresponding approximated graphs are presented in Appendix G and Appendix H, respectively. The weekly gains of classes using the aids and those not using them are contained in Table 8 and represented graphically in Figure 4. These gains indicated how classes using the learning aids compared to those not using them. The standardized scores and the gains were calculated and were obtained in the same manner as that for the English language tests. As indicated by Table 8 and Figure 4, pupils using the math aids made greater improvement in arithmetic scores than those not using them. However, this difference was evident only after Test 8.

A comparative analysis of the gains made by each group before and after the gains (Figure 5) indicated that the group of pupils using the aids for eight weeks showed the biggest improvement following introduction of the aids, suggesting a positive impact of the aids. A statistical analysis of the test results also suggested that there were no significant differences between the performance of girls and boys. A comparison of the improvement in arithmetic of more able and less able students was also made. Though an ability test was conducted prior to the experiment, for the analysis scores below the initial scores were considered to be representative of "less-able" pupils and scores above the initial score were considered to be representations of "more-able" pupils. As Figure 6 shows, the impact was

TABLE 8

Weekly Improvement of Math Scores
of Groups Using the Arithmetic Aids
Compared to Groups Not Using the Aids

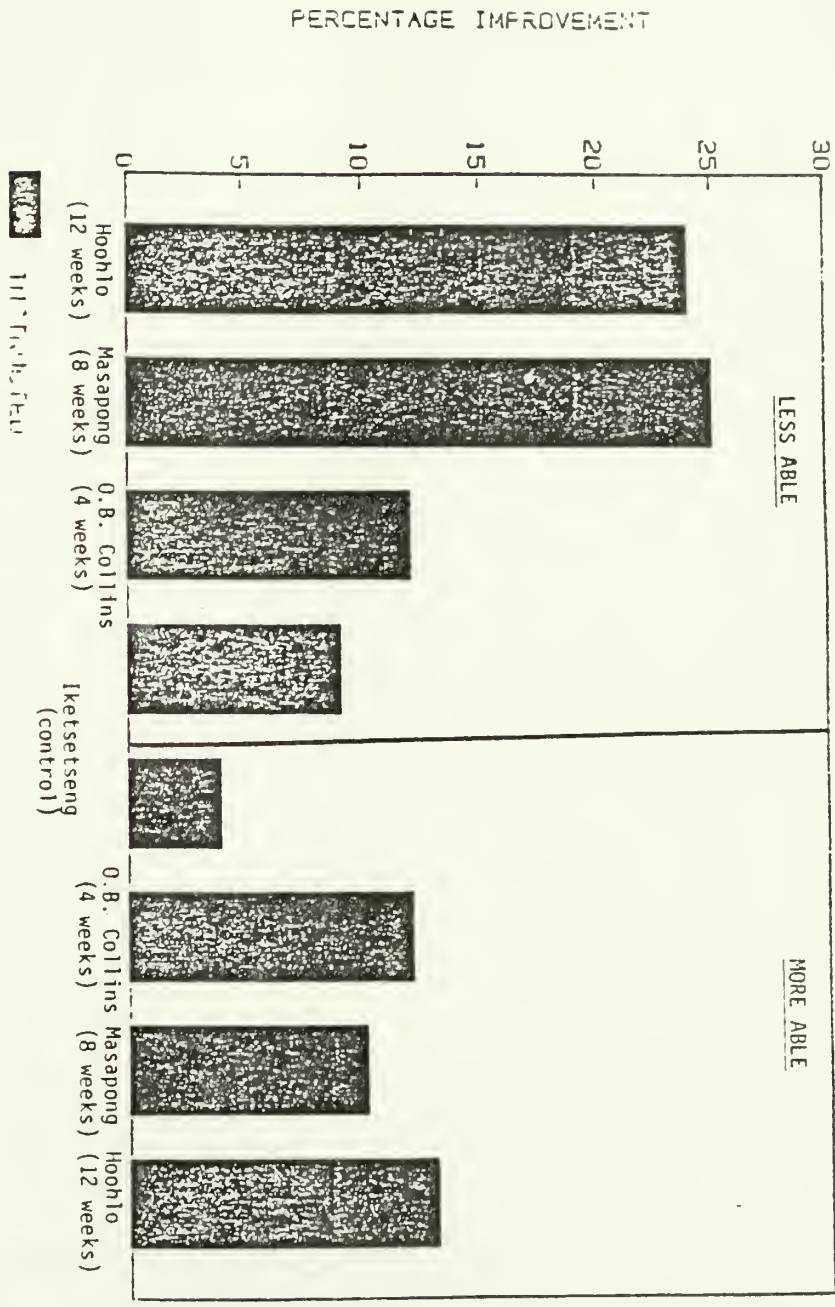| Test	Improvement
Groups Using Aids	
2	-.29
3	.43
4	.67
5	.05
6	-.04
7	.24
8	.64
9	.99
10	1.27
11	.92
Groups Not Using Aids	
2	-.05
3	.72
4	.67
5	-.06
6	-.29
7	.26
8	.65
9	.48
10	.83
11	.67

Source: Electronic Aids in a Developing Country,
Center for International Education,
University of Massachusetts, Amherst.
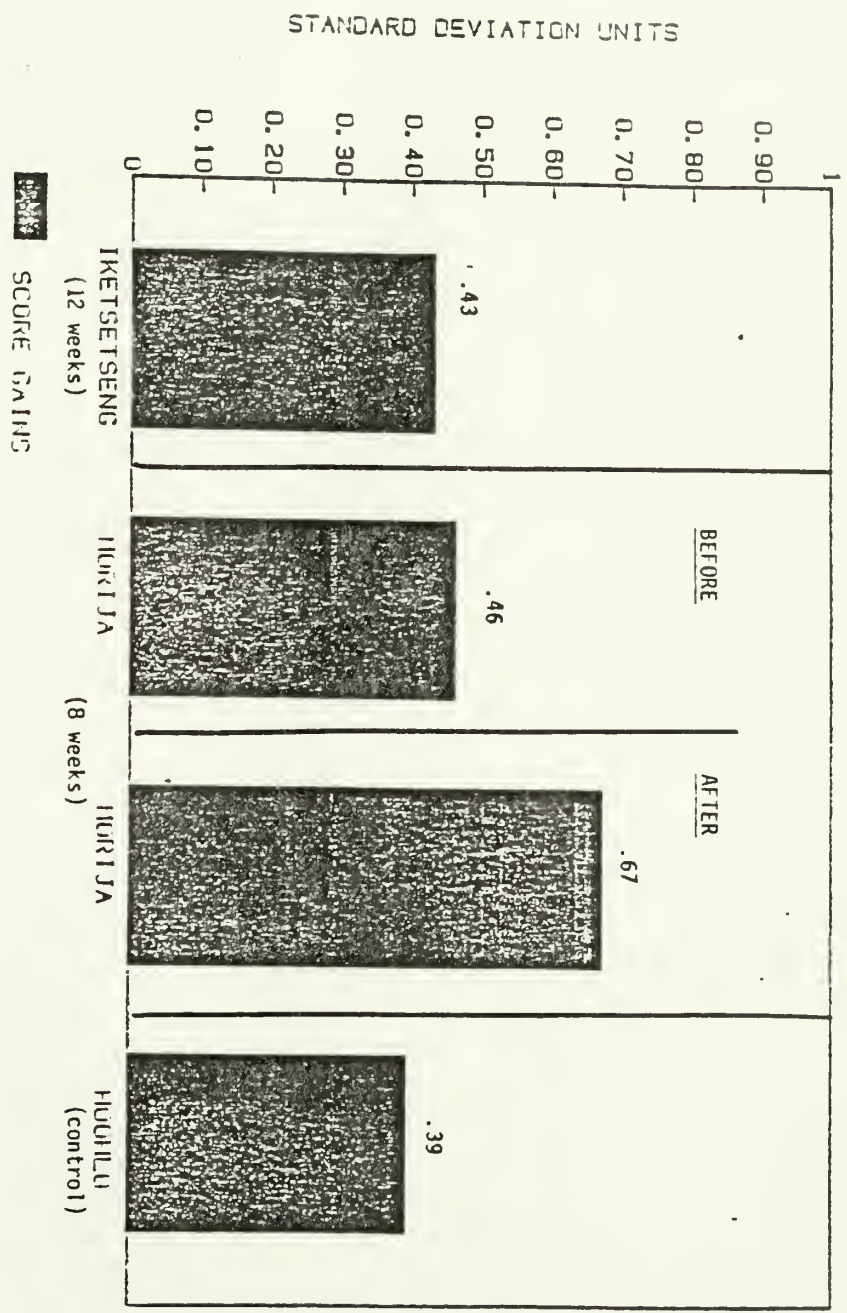
Average Weekly Improvement in Arithmetic Scores
Before and After Introduction of Aids

FIGURE 5
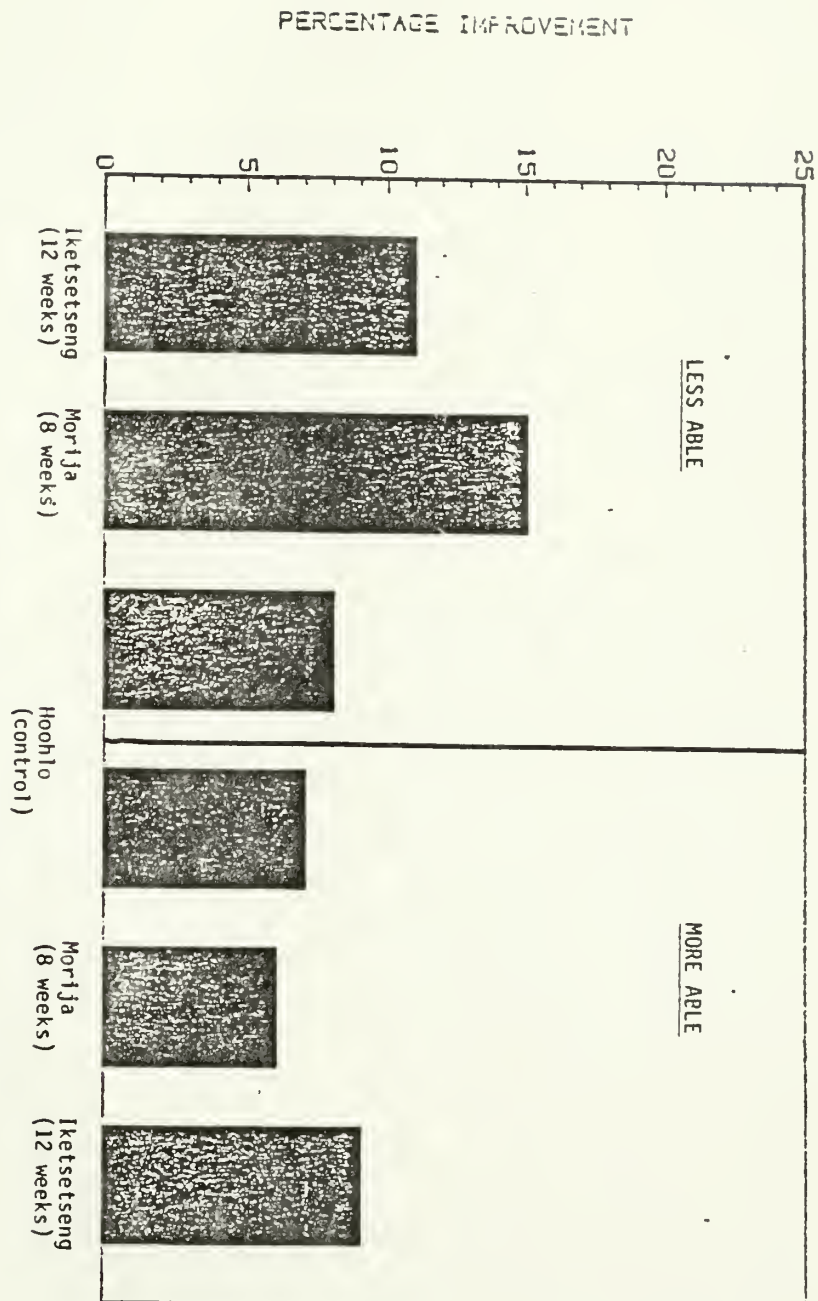
Improvement in Arithmetic scores of Less Able Pupils
Compared to More Able Pupils

FIGURE 6

greatest among the less able pupils. Additionally, since the gains made by less able pupils in the control classes were not equal to those using the aids, it was deduced that the improvement of scores was not due to practice in taking tests.

Summary of the Analysis of Application Issues

Technical Feasibility

Results from the exploratory study indicated that the learning aids met the requirements of technical feasibility. Pupils were provided with the requisite exposure to the aids. Data on the longevity of batteries showed that they performed satisfactorily with respect to their specified lives. The recurrent costs associated with the replacement of batteries, given their extent of performance, however, would be an important consideration in assessing their viability in the context of Lesotho.

The durability and safety of the aids during the experiment was unquestionably high. However, it cannot be deduced with certainty that this level of safety and durability will be replicated during long term large scale use of the aids. The technical characteristics of the aids, namely, the voice and visual display, were found to be sufficiently intelligible for pupils to use them without difficulty. However, as implied by the observation,

improvements in the accent would definitely enhance their acceptability.

Learning Effects

Analysis of the data on learning effects suggested positive effects of the Speak and Read and the Speak and Math on pupil achievement. The effects of the language aid were more pronounced probably due to their use in an appropriate grade level. Though significant gains were made by all pupils, in the case of both the language and math aids, the effects were more pronounced in the case of less able students. This finding was not considered surprising by the researchers given the remedial value of drill and practice for improving basic skills. Given that the basis of the design was one of a "logic of plausibility" the results indicated that it was implausible that the aids did not have a positive effect on learning.

Analysis of Organizational and Long-Term Issues

Analysis of organizational and long-term issues was predominantly qualitative. The analysis was conducted at two levels. At the primary level the analysis was conducted to assess the following factors of interest:

1. Initial size up of the innovation by the pupils, teachers and administrators.

2. Changes, as perceived by the participants, that would enhance the use of the innovation at the classroom level.

3. Modifications that would enhance the acceptance of the innovation at the organizational level.

In order to address these factors each questionnaire had a set of objectives and a set of questions associated with the objectives. Questions were coded according to the factors and categories associated with the specific objectives they represented. Responses to each set of questions were analyzed on the basis of majority and minority opinion.

At the secondary level, summarized results of the preceeding analysis were analyzed to discern how they fitted within the framework of ORACLE.

Primary Analysis

This analysis, for all three categories of respondents, i.e., pupils, teachers and administrators is presented according to the following format: The objectives of each interview with the corresponding set of questions* is presented. Wherever relevant the numbers responding in a particular way are indicated. A qualitative analysis of the responses is then presented. It must be mentioned here that the qualitative results presented were not only based

_____

*It should be noted that some questions were associated with more than one objective.

on the responses to the interviews but also on observations from informal conversations and meetings.

Interviews with Learners (Pupils)

A random sample of twenty three pupils, six from each of the test streams in the participating schools were interviewed. Approximately half the interviewees were female. The interviews were conducted both in English and Lesotho (the local language in Lesotho), with the assistance of interpreters.

The interview questions were designed with the following objectives in view:

I. To gain knowledge of the extent of acceptability, product knowledge and opinions regarding use of the learning aids on the part of the learners. Questions toward this objective wand the corresponding response scores were: [Show the aids to the pupil]

1. What is/are these? What are their names? 12/11*.
   *12 pupils knew them as learning aids and identified the names correctly; 11 pupils only knew them as learnings aids.

2. What subjects do they help you in?
   Subject   English   Math
   Number   12   12

3. Do you like using these aids?
   Yes - 23

4A. What do you like most about these aids?

4B. What else do you like about the aids?

4C. Do you like the aids because

    a) they speak?   23

    b) they are easy to hold?   23

    c) they are easy to read?   23

    d) the words are easy?   11

    e) the arithmetic problems are easy? 12

    f) they help you understand English words better? 11

    g) they help you do arithmetic better? 12

    h) any others?   1*

5. What do you like least about the aids? Why?

6A. Are the words that the aids give you

    too easy or   6

    too difficult

    or about right   5

6B. Are the problems that the aids give you

    too easy or   5

    too difficult   1

    or about right   6

7. Can you understand the pronounciation of the aids when they speak to you?

    Yes   21

    No   2

25D. Do you recognize words and problems in the tests that you have seen in the machines?

Yes   17*

No   1   5 No response

26.   Are you getting tired or bored of the aids?

Yes

No   23

27A. Are the aids helping you to do arithmetic better?
[Speak & Math]

Yes 12

No

27B. Are the aids helping you know and understand English
works better?

Yes 11

No

*Given the time limitations, group interviews were
conducted where each question was asked of each of the
interviewees and responses separately recorded.

II.   To derive information on preferences regarding the
innovation and the intervention process. Questions
addressing this objective and response profile* were:

 5.   What do you like least about the aids? Why?

6A.   Are the words that the aids give you

too easy or   6

too difficult

or about right   5

6B.   Are the problems that the aids give you

    too easy or   5

    too difficult   1

    or about right   6

7.   Can you understand the pronounciation of the aids when they speak to you?

    Yes   21

    No   2

12.   How many people are in the group you work in?

    3 - 6

    4 - 17

13.   Do you think that the number of people in the group is

    a) too much   5

    b) too few

    c) just right   17

14.   Do you get to use the aids as much as everyone else in the group?

    Yes   19

    No   4

15.   Do other people in the group help you when you are using the aids?

    Yes   19

    No   2

        2 No Comment

16. Do you help them?

   Yes   22

   No   1

17. When using the aids in a group, do you say the answer
    and press the buttons or does the group say the answer
    and you press the buttons?

18. Do you prefer to work by yourself with the aids or with
    a group?

   Group   15

   Aids   6

            2 No Response

20A. Are you satisfied with the amount of time that you use
     the aids now?

   Yes   12

   No   8

           3 No Response

20B. Would you like more time?

   Yes   8

   No   12

20C. Would you like less time?

   Yes

   No   20

21. If it were possible, would you use the aids during
    breaks or after school hours?

Breaks   5

After School   12

                    6 No Response

22. What does your teacher do when you are working with the
     aids?

23. Do you call him/her for help when you have a problem?

     Yes   23

        No

24. What would you like your teacher to do when you are
     using the aids?

25A. Do you like taking the tests?

     Yes   21

        No

           2 No Response

29. Can you think of anything that you would want to change
     in the learning aid or its use?

Pupil Reactions

     Pupils' qualitative responses were in summary as
follows:

I. Extent of Acceptability; Product Knowledge; Attitudes

     All the children interviewed displayed a high degree
of familiarity with the aspects of the aids, (i.e., teach
English or Math) although approximately half of them did not
identify the aids by their specific names (i.e., SER or

SIM). They were also totally knowledgeable of the operations of the aids.

Pupils indicated considerable receptivity and enthusiasm about the aids, giving the following reasons for their favorable attitude:

 i) the immediate feedback feature of the learning aids, which enabled them to see their errors and correct them or be informed of the correct answers;

 ii) the practice provided by the aids, helped them improve their English/Arithmetic skills;

iii) the aids introduced words and problems that were, hitherto, unfamiliar to them;

 iv) the aids helped them in their regular classes because they could associate what was presented in the class with what they had seen or heard in the aids (for e.g. levels in arithmetic problems);

 v) the audio feature of the aids which helped them identify words and which provided excitement and fun;

 vi) the visual display in the aids which helped them with spelling and also came in handy when they had difficulty hearing or understanding the machine's voice;

vii) the aids were easy to use. Pupils felt that the accent in the machines, thought initially a problem, had ceased to be one, after use over a period of time.

In terms of the group process, they mentioned that, in most cases, there was equal time sharing of the aids by all.

The general process involved rotating the aids between each
member of the group and problem solving, first by the
individual with the aid and subsequently by the entire
group. None of the children interviewed felt either bored
or tired of using the aids. Most of the children
interviewed mentioned that they did not find anything that
they disliked about the aids. However, the few who did not
share this opinion mentioned the following features of aids
that they did not feel comfortable with:

a) some of the words presented by the aids, were not the
   same as the words that the children used, in associating
   them with the object or function the words represented,
   in the context of Lesotho (for e.g. the word VAN in
   Picture Read). Similarly the symbol for division (÷ as
   different from /) also posed problems.

b) the presentation of problems in random order of
   difficulty. There was no progression in the level of
   difficulty.

c) the lack of control over the tone of the voice in the
   aids.

d) rare occasions when the aids gave incorrect feedback to
   a correct response during repetition of a problem.

   Children observed that while they were using the aids
their teachers were usually involved in monitoring the
score-keeping and helping them whenever needed.

II.   Preferences Regarding the Innovation and its Use

As could be inferred from the negative aspects of the learning aids, mentioned above, the pupils interviewed favored the following:

a) local words and symbols.

b) presentation of problems in increasing order of difficulty and levels.

c) control over the tonal quality of the aids.

It must be mentioned here that, although most of the children interviewed felt that the pronunciation and accent was not a problem after a length of time, actual observation by this researcher indicated otherwise.

Pupils indicated a strong preference for group-work as against individual usage. The preferred group size was "three". In fact, the respondents who were not satisfied with the group size, during the study were all from groups of four. Distraction, and the logistics of sharing with four people in Lesotho classrooms, were mentioned as the primary reasons. Children stated that they preferred that the aids used English rather than Lesotho as the opportunity to learn Lesotho was available at home, whereas that for English was not. They also indicated that the aids would be most useful for helping them with arithmetic.

The majority of the pupils expressed satisfaction with the amount of time (45 minutes) that the aids were being

used during the exploratory study. The major reasons stated
for this opinion were:

a) the small periods of usage encouraged them to think and
   work faster

b) they were concerned that longer periods would result in
   larger consumption of batteries and hence be more
   expensive for the schools.

Pupils also felt that the words and problems were
quite easy, indicating that modules of varying levels of
difficulty would be preferable.

All the children interviewed also liked the testing
aspect of the process. The reasons mentioned for this were:

a) the texts were not too difficult.

b) it provided important feedback on their performance.

c) it helped them with their regular performance in both
   arithmetic and English.

In terms of their opinions regarding the role of the
teacher while they were using the aids, the respondents
mentioned the following in order of preference:

 i) the teacher should be in class helping the students.

ii) the teacher should stay out of the class or not
    supervise, as the teacher's presence impaired individual
    working. Also, since they have (or should have) already
    been taught the concepts, they should have the
    opportunity to work alone.

Again the segment of respondents who felt that the teacher's absense was necessary, felt so, because in their opinion teachers were prone to giving out the answers too soon, whereas they (the children) preferred to take their time to solve problems independently.

Finally, most of the children interviewed were of the opinion that other schools should also be provided with the aids.

Interviews with Teachers

Interviews were conducted with all six of the test stream teachers based on a questionnaire that was developed for this purpose.

The principle objectives of the interviews with teachers along with the questions that addressed these objectives were as follows:

I. Obtain information from the teachers on their attitudes towards the learning aids and their opinions regarding the aids' usefulness or lack thereof. Questions addressing this objective were:

 1. Do you find the machines (aids) useful?   Yes   6

      If yes, how?

      If no, why?

 2. What problems do you see with

      a) the machines?

      b) their use?

4. Does the material presented by the machines support what
    is normally taught in the classroom?   Yes 4   No 2
       If yes, how?
       If no, how?

6A. Will the use of the aids upset your normal school
     operations? Yes 4   No 2
        i) in terms of curriculum   No 6
        ii) scheduling   Yes 3   No 3

6B. If yes, how?

7.   Do you feel the children are prepared, culturally, to
     use these aids and learn from them?
        Yes 5
        No 1

9.   Does the use of the machines cause any discipline
     problems in class?
        Yes 2
        No 4

11A. Do you think that the accent in the machine is a
     problem?
        Yes 5
        No 1

11C. Assuming the accent is a problem, do you think that it
     is worthwhile to invest more to change the accent?
        Yes 6

17. For the amount of time the aids are used, do you think the extent of matters covered as compared to regular teaching is

   b) more   5

   c) about the same 1

18. What is the best thing about the aids?

19. What is the worst?

20. Do you think that children would soon get bored of the aids?

   Yes 1   younger? Yes

    No 5   older?   No 6

24. What do they feel about the machines?

25. Do they want it in their classes?

28. How do you feel the teachers role/function changes with the use of the machines?

29. Do you think the aids would allow teachers to give more individual attention to children?

   Yes 6

32A. Do you feel all schools should have these aids?

   Yes 6

32B. Do you feel all classes should have these aids?

   Yes 6

33. What subjects, do you feel, would these aids be most useful in teaching?

34. How did you feel about the aids in the beginning?

35. How do you feel about them now?

36A. Do you feel that the aids are easy to use?

   Yes   6

37. If your school had to buy the aids, do you see them as
     being useful enough to pay for them?

     Pay entirely?   2

     Subsidized?   4

II. Gain information on teachers' opinions of pupils'
reactions to the learning aids. Questions addressing this
objective were:

  3. Do you feel that the children adjusted easily to the
      machines?

  7. Do you feel the children are prepared, culturally, to
      use these aids and learn from them?

      Yes   5

       No   1

15B. Do you think that the children in the groups are being

      a) cooperative or   3

      b) competitive   4

20. Do you think that children would soon get bored of the
     aids?

      Yes   1   younger?

       No   5   older?   6

21A. What do you think the children like most about the
     aids?

21B. What do you think the children like least about the aids?

22. Do you feel that children will start losing respect for the teachers because of the machines?

    No 6

III. Get teachers' opinions and preferences regarding a) product characteristics and b) method of use. The related questions were:

4. Does the material presented by the machines support what is normally taught in the classroom?

    Yes 4   No 2

    If yes, how?

    If no, how?

8. At which level (standard) do you feel that the use of the aids could be most beneficial?

    Standard 7   6   5   4   3   2   1

    Number   2   6   1   6   2

10A. Do you feel that children could be left unsupervised while using these machines?

10B. If yes, at what standards?

12. Do you feel it is more preferable to use these aids for English or Sesotho?

    English   6

    Sesotho   2

13. Do you feel that the amount of time that the machines are being used now is

a) too little   1

b) too much

c) about right   5

15A. What do you think should be the size of the groups using the aids?

Size   3   4   2

Number   4   1   1

16. Do you think it is preferable to use the aids

a) in groups or

b) individually

17. For the amount of time the aids are used, do you think the extent of matters covered as compared to regular teaching is

a) less

b) more   5

c) about the same   1

29. Do you think the aids would allow teachers to give more individual attention to children?

Yes 6

36B. How do you feel teachers could improve the use of the aids?

38. Do you think the aids will be more useful in rural schools or urban schools?

Rural   5

Urban   6

Why?

IV.   Obtain teachers' opinions regarding factors which might contribute towards more effective and extensive usage of the learning aids.   The questions addressing this objective were:

4.   Does the material presented by the machines support what is normally taught in the classroom?

   Yes   4

    No   2

   If yes, how?

   If no, how?

5.   Do you feel that teachers would require major retraining to use these machines on a large scale?

6A.   Will the use of the aids upset your normal school operations?

   Yes   4

    No   2

   i) in terms of curriculum

   ii) scheduling

6B.   If yes, how?

8.   At which level (standard) do you feel that the use of the aids could be most beneficial?

   Standard

   Number

10A. Do you feel that children could be left unsupervised while using these machines?

Yes   3

No   3

10B.   If yes, at what standards?

12.   Do you feel it is more preferable to use these aids for
       English or Sesotho?

       English   6

       Sesotho   2

13.   Do you feel that the amount of time that the machines
       are being used now is

       a) too little   1

       c) about right   5

15A.   What do you think should be the size of the groups
       using the aids?

       Size   3   4   2

       Number   4   1   1

16.   Do you think it is preferable to use the aids

       a) in groups or

       b) individually

17.   For the amount of time the aids are used, do you think
       the extent of matters covered as compared to regular teaching
       is

       a) less

       b) more   5

       c) about the same 1

29.   Do you think the aids would allow teachers to give more
       individual attention to children?

Yes   6

36B. How do you feel teachers could improve the use of the aids?

38. Do you think the aids will be more useful in rural schools or urban schools?

Rural   5

Urban   6

Why?

V. Gain feedback on the exploratory-study process. Questions to address this issue were not included in the questionnaire. However, all the respondents were asked about their opinions regarding the process during the course of the interviews.

Teacher Reactions

The reaction of teachers toward the learning aids was sampled by interviewing the six teachers of the experimental classes. These included two Standard Six teachers and four Standard Four teachers. Questions posed to the teachers were intended to obtain their opinion of:

1) the learning aid and its usefulness

2) pupil reaction to the aids

3) preferences regarding features of the aids and methods of using them

4) factors which might influence more effective or extensive use of the aids and

5) the research in which they were participating.

Among all the participants in the experiment, teachers were the most doubtful initially about the value of the learning aids. None of the teachers had ever seen an electronic learning aid and most knew little about computers. Their initial reaction to the learning aids in this project, therefore, was one of surprise and in some cases intimidation. Many expressed wonder at how such a device could talk and yet not have a cassette tape inside.

There was also apprehension and skepticism of how this strange and new device might affect them as teachers. Many doubted their own ability to understand it well enough to explain its use to their students. One teacher felt the aid might be "too effective", in which case it would detract from pupil interest in other subjects. All teachers in the sample expressed some uncertainty about the purpose of the learning aids and their relevance to the syllabus normally followed.

All the teachers attached sufficient importance to the government's endorsement of the project to agree to accomplish the goals of the experiment.

These initial attitudes become more meaningful in light of the typical conditions under which Basotho teachers work. Compensation is low and includes few fringe benefits or prospects of advancement. Classrooms are unusually overcrowded and underequipped and often serve more than one

class at a time. Classes are often heterogenous mixtures of ages due to the presence of repeaters. Faithful adherence to the official syllabus is expected of teachers in order to prepare pupils for a Standard Seven leaving exam.

Many of the early fears teachers harbored were allayed through continued experience with the aids. Their initial apprehensions were replaced by a willingness to consider the potential value of the learning aids in their classroom setting.

Being able to explain the learning aids to their pupils was one of the early fears that was encountered. However, practice with the aid prior to introduction in their classes was sufficient to convince all six teachers of its ease of operation. More importantly, after the introduction of aids in their classrooms, teachers discovered that most pupils were able to master even difficult functions of the aids without detailed explanations or knowledge required of them.

Teachers also expressed early concerns about possibly unfavorable comparisons between their teaching and the learning aids. However, none reported any fear or threat to their authority due to the presence of learning aids in their classrooms. Teachers also felt that their conventional teaching of other subjects also would not suffer by unfavorable comparison to the learning aids.

Another reason for the acceptance of learning aids by teachers was their perception of a high degree of acceptance by their pupils. Five out of the six teachers praised the capacity of the learning aids to motivate and engage pupils in the task. The voice and visual feedback as well as the element of surprise in the way the material was presented were cited as responsible for the favorable pupil response. Despite initial difficulties, the majority of pupils generally adapted well to the aids in the opinion of their teachers.

Drill and practice arithmetic and vocabulary were singled out as the most useful features of the aids, due to the difficulty of making sufficient time available in the classroom for these activities. Teachers also mentioned the capacity of the aids to serve the special needs of students as a positive aspect of the aids. In this regard they mentioned the two-fold level of individualized activity that was possible in classrooms. For example, more individual attention would be given to less able students while more able ones worked with the aids. Group activity which the aids facilitated, was also considered a positive feature of the aids, this because group work was normal in Lesotho's classrooms and because it promoted competition and cooperation which was seen as having positive implications.

Teachers, of course, were not without criticism of the learning aids. Some of their criticisms were explicitly

stated; but often they could be inferred from the teachers' own behaviors in the experiment.

A frequently mentioned complaint of the learning aids was the randomness of the presentation and its lack of fit with the syllabus. Although admitting that the built-in difficulty levels gave some measure of control, some teachers were disappointed by the aids' inability to present problems more systematically as would be done in conventional lessons. A perception that learning aids did not facilitate the task of covering the syllabus may have been responsible for the somewhat lower level of use among the few teachers who voiced this concern.

Informal conversation among participating teachers revealed this perceived incompatibility with the syllabus to be more pronounced among the staff of expensive, urban schools than of less expensive rural schools. Because their enrollments include many children of highly educated parents, elite urban schools are expected to demonstrate their excellence through superior performance of their pupils on the Standard 7 leaving examination. Close adherence to the national school curriculum is viewed by staff and parents of pupils at these schools as essential for achieving outstanding test results. Such schools may, therefore, require considerable adaptability by the aids to specific curricular objectives for deployment to succeed.

Rural schools, on the other hand, seem to offer a far more flexible environment for exploring curricular options.

Similar reservations were expressed about the aids' perceived inability to sustain pupil motivation after extended use. Although most teachers believed their children would not soon become bored of the aids, they also predicted that lengthening the time of the session or increasing their frequency would raise the level of boredom, especially among older students. In fact, Standard 6 teachers, particularly those who used the language aids over the entire twelve weeks, did observe increased boredom and distraction among their students. Teacher logs show that these teachers brought out the aids less frequently and used them for a shorter time than teachers of lower standards. Repetition of programmed words and problems, even after pupils had reached criterion, was blamed for much of this boredom. Teachers recommended restriction in the use of the aid to 45 minutes, 2 days a week.

Teachers' responses included several proposed modifications to make the learning aids more effective. Among these were suggestions to improve the quality of the voice, make it louder, and to program the aids with local word lists. Several teachers mentioned that some of their pupils still had difficulty understanding the voice. Also recommended was a less random presentation of material which would allow better control over the sequence of learning.

Teachers felt literature should be provided along with the aid to insure better understanding of the machine's operation. Finally, there was support for holding workshops to familiarize teachers with the aids' operation and the teacher's role in the classroom.

Teachers stressed the fact that though pupils could be left unsupervised while using the aids, their real effectiveness could be realized only with teacher facilitation. This was necessary because a) the aids, regardless of their usefulness would not teach concepts and were only supplements to regular instruction, and b) the safety and maintenance of the aids had to be considered, given classroom conditions in Lesotho.

In terms of the exploratory study process, teachers expressed satisfaction with the extent of preliminary information on the objectives, usage and the assistance during the project, provided by the researchers. The only mild notes of negativeness about the process that were expressed, were regarding the timing of the project.

In the teacher's opinion the exploratory study should have commenced earlier, firstly because it would have given all concerned more time to prepare themselves in the use of the aids and more importantly because it would have given time for adjustments that had to be made, in terms of class schedules and room allocations given the impending 7th standard exams.

<u>Interviews with Administrators</u>

A sample of educational administrators who were familiar with the electronic aids and the exploratory study were interviewed. The target sample was chosen so that it would provide a wide and diverse spectrum of opinions and comprised the following:

  i) the English and Math curriculum affairs from the National Curriculum Development Center, Lesotho (NCDC).

 ii) the Chief Education Officer at the Education Ministry, Lesotho

iii) the Chief Educational Planner, Education Ministry, Lesotho

 iv) the Curriculum Director, NCDC, Lesotho

  v) the Director of the Lesotho Distance Teaching Center (LDTC), which was the collaborating institution.

The sample chosen is representative of the educational planning decision-making body in Lesotho, both in terms of curriculum and administration. The interviews with administrators focused on the following objectives:

I. Discern their opinions and attitudes towards the aids and their usefulness in the context of Lesotho. Questions addressing this objective and the corresponding response profiles were as follows:

1. In your opinion, do/can the use of any audio visual aids supplement or help improve education?

    Yes 7

2. In your opinion, how important is the role of drill and practice in a) language and b) arithmetic.

    a. Language: b. Arithmetic:

        High   5   High   6

        Medium   1   Medium   1

5. Do you think that the use of these aids will supplement or help improve education?

    Yes 6   No 1

6. Do you think that these aids will help children with drill and practice?

    Yes 6

7. Do you think a mechanical device is worth being considered to explore its use in improving education?

    Yes 4   No 1

8. What was your response when you first heard that these electronic aids were going to be tested in Lesotho? (Briefly.

11. Given the fact that there are undertrained teachers in Lesotho, do you think aids like these would be:

    Very useful 4   Moderately useful   No difference 2

    Reasons:

12. Given the fact that teacher aids are scarce and expensive, do you think aids like these would be:

Very useful 4   Moderately useful 1   No difference 1

Reasons

13. Given teacher absentism, do you think aids like these
     would be:

     Very useful 3   Moderately useful 1   No difference 2

     Reasons:

14. Given that drill and practice is a mechanical task
     which teachers would find boring, do you think aids
     like these would be:

     Very useful 5   Moderately useful   No difference 2

     Reasons:

16. Given that adaptations to use local word lists and
     speakers would make the aids more expensive, would they
     still be worthwhile?

          Yes   3   No   2   Abstained   2

II. Derive the factors and issues that they would address
to make decisions regarding extensive and effective use of
the aids. Questions directed towards this objective and the
corresponding response profiles were:

 9. How would you rate the following in terms of their
     importance in deciding whether these aids should be
     used?

     VI = Very Important

     MI = Moderately Important

     NI = Not Important at all

		VI	MI	NI
1.	Teachers like the aids	4	3	
2.	Children like them	7		
3.	Teachers feel that they are useful	5	2	
4.	Students feel that they are useful	7		
5.	Scores show they improve language learning (tests)	6	1	
6.	Scores show it improves arithmetic learning (tests)	4	2	1 (NA)
7.	Curriculum developers like them	2	4	
8.	Administrators like it	3	3	
9.	The cost of the aids	6		
10.	They do fit into the curriculum	5	2	
11.	They do not upset normal school operations (classes, subjects, etc.)	2	4	1
12.	They are durable	3	2	2

11. Given the fact that there are undertrained teachers in Lesotho, do you think aids like these would be:

Very useful 4   Moderately useful   No difference 2

Reasons:

12. Given the fact that teacher aids are scarce and expensive, do you think aids like these would be:

Very useful 4   Moderately useful 1   No difference 1

Reasons:

13. Given teacher absentism, do you think aids like these would be:

Very useful 3   Moderately useful 1   No difference 2

Reasons:

14. Given that drill and practice is a mechanical task which teachers would find boring, do you think aids like these would be:

Very useful 5   Moderately useful   No difference 2

Reasons:

17. If the present pilot study indicates that scores improve and that teacher and student attitudes are favorable, which of the following would you consider as the next best step:

a) Introduce the aids in some more schools
   and test the effect 5

b) Introduce them to all schools in a district

c) Introduce them on a national level 1

d) Try them in another country

e) Discard their use totally

*Reasons overleaf

19. If these aids were to be used in a developing country (such as Lesotho) how would you rate the following factors in terms of being obstacles in large scale use. (Please give reasons wherever relevant.)

SCALE: D = Difficult; M = Manageable; DBW = Difficult But Worthwhile; E = Easy; NO = Not an Obstacle at all

	D	M	DBW	E	NO
1. Initial Procurement costs	3	1	3		
2. Maintenance lists (recurrent: battery expenses, replacements, storage)	5	1		1	
3. Retraining of teachers	1	1	1	2	1
4. Rescheduling of school operations (classes, periods, etc.)	1	1			5
5. Parents' attitudes towards use	1	1	1	1	3
6. Teachers' attitudes towards use	1	2	1	1	2
7. Children's attitudes towards use					7
8. Administrators' attitudes towards use	4	1	1		1
9. Ability to develop materials to support the use of these aids	4	2			1
10. Issues of maintenance; storage, breakage, replacements, batteries, etc.	4	1	1		1

10. Do you think it is more important for the aids to teach using Sesotho or English?

Sesotho 5   English 7

15. Do you think that these aids would be more effective if they used local word lists and speakers?

Yes 5   No 1

18. How do you think these aids would fit <u>best</u> in the
    existing curriculum in schools?

    a) As a supplement for all for drill and practice   6

    b) For remedial learning for weaker students   5

    c) To keep better students occupied while
       teachers help the weaker ones   4

    d) Any others; (please list)

18A. How do you think these aids would fit best in the
    existing school day?

    a) Use them in the regular English and Math classes   6

    b) Use them in the children's recess   1

    c) Use them after school

    d) Use them at home and not in school   2

    e) Any others; (please list)

    Administrators' responses to the questions relating to
the two objectives were, in summary, as follows:

I. Opinions and Attitudes Towards the Aids and Their
   Usefulness

    Administrators, at the outset, emphasized that they
perceived that the use of audio visual aids and the role of
drill and practice were important constituents of the
educational process. However, they qualified their opinions
with the following observations:

a) the design of audio visual aids in terms of their
   suitability to the specific context where they are used

is an important factor in realizing the potential
benefits of any educational aids. For instance,
simplicity of operations and the ability to promote group
work would be important design parameters in the context
of Lesotho. An illustrative case in point was made by
one of the administrators, with regard to the importance
of the design aspect by referring to an experimental
learning aid introduced by Macmillan & Company in
Lesotho; the experiment used folded cards placed on a
clothes line in outdoor classes to teach literacy and
numeracy skills--the aids were unsuitable because the
winds in Lesotho made it impossible to keep the cards on
the line!

b) educational aids could be effective only if teachers who
used them were well trained enough to put them to good use.
Administrators referred to other mechanical devices such
as radios and tape recorders which could have been very
useful educationally in developing settings, but
whose potential was not exploited due to ill-trained
teachers.

c) the role of drill and practice in reinforcing what is
taught can be realized only after the underlying concepts
in any subject matter have been sufficiently implanted.

d) in order to sustain the interest of learners, drill and
practice should be presented in a game format in order that
the "fun" aspect of it is maintained.

Administrators mentioned that their initial reactions to the learning aids was a mixture of wariness, interest, curiosity, excitement about the educational possibilities of the aids and a feeling that the aids were expensive. They were also skeptical, initially, about the potential usefulness of the aids because of the history of unsuccessful attempts to introduce technology for educational development, especially in third world countries. However, after observing demonstrations of the aids' capabilities and their use in classrooms, administrators felt that the potential of these aids to enhance education was worth exploring. Two of the respondents (the math curriculum officers) did express reservations about the exploratory study with the learning aids, for the following reasons:

a) that neither they nor the National Curriculum Committee were consulted prior to its commencement, as was generally the practice in Lesotho. It must be noted, however, that response from other administrators were contradictory to this point of view.

b) that the testing of a "mental math" curriculum package which had been developed was postponed in order that the exploratory study on the learning aids could be conducted. The math curriculum officers were of the view that the mental math curriculum package which _they_ had developed was more suitable for Lesotho schools at that

time than the learning aids, though they did mention that
the aids had tremendous potential for drill and practice.
Administrators were of the opinion that audio visual aids
were long needed as supplements in third world educational
settings, such as in Lesotho, in order to offset the
disadvantages due to:

a) the lack of teachers and teacher absenteeism (most
   teachers are handling more than one subject).

b) high student-to-teacher ratios.

c) the high cost and the lack of teacher aides. (Staff
   salaries are the biggest component of the educational
   budget in Lesotho.)

In their opinion, the learning aids could be a strong
potential candidate in this regard, if their learning
benefits and cost effectiveness could be established. One
respondent observed that given the audio visual and drill
capabilities of the learning aids, they would be preferred
(in terms of effectiveness and ease of use) replacements for
flash cards, which are being used in some Lesotho schools.

Besides the capability of the learning aids to
reinforce subject matter that had been taught, the following
aspects of the aids were considered favorable by the
administrators:

a) they were small, portable and easy to use.

b) they could be used to an advantage for drill and remedial
   learning by both weaker and gifted students.

c) they freed up teachers' time for them to plan their
   lessons and to provide more individualized attention to
   pupils.

II. Factors and Issues to be Addressed for more Extensive
     and Effective Usage of the Aids

     The costs of procuring and maintaining (repair and
replacement) the aids was mentioned by all as the major
factor in the decision to use the electronic learning aids.
The cost factor was considered especially significant,
because the aids would have to be provided to all schools
for reasons of equity, political considerations and because
of the trend of increasing enrollments in Lesotho schools.
Two streams of opinions were expressed regarding the cost
factor. The minority stream indicated that, given the
current dearth of basic educational resources (desks,
printed materials, etc.), it would be inappropriate to
promote the extensive use of the learning aids, at the
present time, in Lesotho schools. The majority stream,
however, was of the opinion that cost benefit or cost
effectiveness (and not cost alone) was the critical issue.
Hence, if the effectiveness of the learning aids as
supplements in the educational process was demonstrated and
established, then, given the impetus on education in Lesotho
and the potential benefits of an educated youth population,
cost obstacles should and could be surmounted.

Favorable attitudes of teachers and children and their perception of the aids as being useful were also considered to be very important in the decision-making process for using the aids. However, they considered teachers' negative attitudes, if any at all, to be an easily manageable obstacle to overcome for large-scale use of the aids. The key to manageability was considered to be the demonstrable effectiveness of the aids as supplements to the teaching process. Administrators were of the view that teachers' training would contribute considerably in terms of improving teachers' attitudes and promote teacher effectiveness when the aids were used--the latter, because the use of the aids decentralized the classroom teaching process and shifted the focus of the teachers' role to that of a facilitator. Administrators' positive attitudes were perceived to be of moderate to high importance by the respondents. Administrators' attitudes were also considered to be potentially difficult obstacles, if extensive use was to be considered. Respondents felt that reluctance on the part of the administrators would be present because:

a) the expenses involved in procuring and maintaining the aids.

b) the additional responsibility that they would have to assume for providing storage and safety for the aids.

c) they would not be in direct touch with the classrooms to
   observe and realize the potential effectiveness and
   benefits of the aids.

The administrators interviewed were of the opinion that
learning effects, as indicated by the language and math test
scores, were important parameters in deciding to use the
learning aids. However, they stressed that it was the total
effects of using the aids, which included teachers' and
students' attitudes, the logistics of use, and cost
effectiveness, etc., which was critical and that the
learning effect was just one aspect.

The need for materials presented by the aids to
support and fit into the curriculum was also considered to
be an important decision-making criterion for the use of the
aids. Lack of this feature would pose a very difficult
obstacle for promoting extensive use, according to the
administrators. On the other hand, scheduling
considerations were regarded to be only of moderate
importance and not to be an obstacle at all by most of the
respondents.

The most of the administrators interviewed were also of
the opinion that the optional way of using the aids in the
existing school day would be to use them in the regular
English and math classes, and mainly as a supplement for
drill and practice and for remedial learning.

Administrators also indicated an inclination towards the use of English rather than Sesotho by the aids except in the case of very low class levels. They also expressed a strong preference for the use of local word lists and a local accent in the aids as, in their opinion, this would enhance the effectiveness of the aids.

In the event that the exploratory study indicated favorable results, in terms of the total effects, all administrators felt that the next best step would be to test the aids in a larger and more varied spectrum of schools in Lesotho; i.e., rural and urban, government and private. A sample size of 100 schools was recommended as being appropriate for a Pilot Study--this being a 10% sample of Lesotho schools. It was also suggested by some of the administrators that it would be prudent to continue testing the effect of the aids in the test schools used for the exploratory study, in order to study the extent to which interest in the aids was sustained and if it was self-generative.

Finally, the majority of administrators interviewed mentioned that negative attitudes towards high technology solutions to educational problems in developing countries, which used to be prevalent, are rapidly giving way to an attitude of trying _any_ kind of solution--given the impetus on educational development. However, inspite of this shift in attitudes, for the learning aids to be used in a

large-scale in Lesotho, considerable educational salesmanship would have to be done and the project would have to assume a "National Project" status.

Secondary Analysis--ORACLE

This section of the chapter applies the dimension of Objects, Resources, Authority, Consensus, Linkage and Environment (ORACLE) to the summarized responses of the interviews and the observations made, in order to examine how they affect the long term, large scale aspects of introducing the innovation. The dimensions of ORACLE as proposed by Havelock and Huberman (Havelock and Huberman, 1980) have been described earlier, in Chapter II. A discussion based on ORACLE as it applies to this study ensues.

Object

The Object dimension comprises five aspects, namely, the relevance or need, promised-benefit, resource demand, complexity and the compatibility of the innovation. In the case of Lesotho the concern over literacy and numeracy education have not only been emphasized by earlier reports but also restated in the course of interviews with educational administrators and teachers. The importance of drill and practice to strengthen literacy and numeracy skills and the problem of a high pupil teacher ratio (65:1) in Lesotho have been mentioned earlier. The learning aids

address these problems to a considerable extent, as was evident from the observations during the exploratory study and the responses of teachers and pupils. They provided extensive drill and practice in English language and Arithmetic. Teachers and pupils in their responses mentioned this as the most important feature of the aids. Additionally, the aids were described as being "easy to use" and hence not complex. They supported the material taught in Lesotho's primary schools, although, as the teachers indicated, not necessarily in the same progression. They also promoted group work which was the normal practice in classrooms. Based on the above observations it can be surmised that the aids would be relevant to the needs of Lesotho's primary education, not complex to use and compatible. In terms of resource demand, though no assistance from external experts would be needed given the simplicity of operation of the aids, outside assistance would definitely be required for equipment and battery supplies. This aspect was repeatedly stressed by teachers and administrators, alike. Considering the various aspects discussed above, the Object dimension can be considered relatively strong.

Resources

Resources include financial, material, human and knowledge resources. Financial resources, as indicated

earlier, were pointed out by all as the major source of concern. Regarding financial resources there were two streams of opinion, as mentioned earlier: one which felt that it was an insurmountable problem, given the already existing paucity of basic materials and facilities in schools; the other which felt that if the gain to education through the use of the aids could be ascertained, then funds could be procured either from external sources or by directing funds from existing programs. The other point of view mentioned in this regard was that, despite increasing enrollments in Lesotho's schools, through increased group usage, costs could be kept low.

All the administrators indicated that material and human resources would not pose any problem, given that facilities to produce support materials were available, teachers were resourceful and most important of all, the aids required little or no support materials or skills for teaching with them. Overall therefore, in terms of the aids, the resource dimension can be considered to be moderate to weak.

Authority

The "authority" component could be considered to be the strongest of the six ORACLE dimensions, if the exploratory study is any indication. The study had the sanction of the Ministry of Education, the Educational

Advisor, the Director of the Lesotho Distance Teaching
Center and the Curriculum Director of the National
Curriculum Development Center, these institutions being the
highest educational decision-making bodies in Lesotho.
Their participation, involvement and active support during
the exploratory study suggests that in the case of long term
large scale adoption, the authority component should be
strong.

Consensus

The unanimity of responses for most of the issues
regarding the aids usefulness, problems and future-use
considerations such as the need to evaluate their overall
impact, suggest that the "consensus" component can be
regarded as being strong. However, there seemed to be a
possibility that during the exploratory study there was
superficial conformity due to the overriding influence of
authority. This was noted during a meeting with teachers
and administrators when some curriculum advisors and
teachers expressed the opinion that they had not been
consulted by the authorities regarding the project, prior to
its introduction, and had merely been asked to co-operate,
after the decision had been made. The implication therefore
is that consensus though strong could be considered to be
due to superficial conformity. This could detrimentally
affect the long term adoption of the aids.

Linkage

Linkage has been described before as being synonymous with human and social infrastructure needed to carry out a reform. Two of the principal constituents of the "linkage" dimension are: 1) whether the solution is politically and materially possible, and 2) whether implementation would be rapid and reliable.

From the responses of the principal decision makers for education, both from the ministry and the collaborating institutions it could be presumed that the large scale introduction of aids would be politically possible. Given the predominant influence of authority in that setting, any dissent would also be overcome. This was evident from the responses of the administrators who were interviewed. They indicated that any opinions of teachers, other administrators and parents though important, were manageable. However there are considerable problems with the infrastructure. Given the relative degree of underdevelopment of Lesotho, there would be considerable problems in the maintenance. Even storage and safety would pose problems in the long term given the lack of facilities. Communications are also not very developed which would cause problems in monitoring the regular use, the safety and the supply of batteries to distant schools. As such there would be a problem of the availability of alkaline batteries in large numbers. Some of these aspects were explicitly

pointed out by administrators in the course of the
interviews; the others deduced by the observations of this
researcher during the study process. Harmonization of the
aids into the regular classroom and curriculum and teacher
training, however, would not pose any problems. Overall,
given the overwhelming weakness of the organizational link,
it can be concluded that the "linkage" component is not very
strong.

Environment

The environment, by and large, would be open and
supportive, as was indicated by the attitudes and reactions
of the teachers, administrators and the collaborating
institutions. Both the responses to the interviews and
informal conversations indicated there is a considerable
impetus on enhancing literacy and numeracy education in
Lesotho. Considering that the aids are intended to serve
this end, there is no conflict with the developmental goals
of Lesotho. Teachers' opinions that the use of the aids
would not be in conflict with their normal teaching routines
is also indicative of a lack of disconsonance with existing
practices in Lesotho. Overall the "environment" component
could be considered to be strong.

In summary, with respect to the use of learning aids
in Lesotho, the ORACLE analysis suggests that the Object
dimension is strong, the Resource dimension is moderate to

weak, the Authority dimension is strong, the Consensus dimension is strong, though it could be superficial, Linkage weak and the Environment dimension was strong.

Summary of Organizational and Long-Term Issues

Results from the analysis of the organizational and long-term issues could be summarized as follows:

All of the three groups--pupils, teachers and administrators--were generally favorable to the use of the aids, though to different extents. Pupils were highly enthusiastic. For most of the duration of usage they maintained a high degree of engagement in the tasks presented by the aids. The voice, visual display and the feedback features of the aids were the features that the pupils found most interesting. They preferred the use of English in the aids rather than Sesotho. They also preferred group usage and demonstrated a willingness to share the use of the aids.

Teachers, though initially hesitant, were receptive to the aids over time. Teachers found the aids to be useful as it provided drill and practice, promoted group work and it generated enthusiasm among the students. They preferred the aids to use Sesotho for lower grades and the matter presented by the aids to follow the progression normally used. Test school teachers also suggested that in the event of large scale use, they could serve as facilitators.

Administrators were cautiously optimistic. They favored the use of the aids, giving the shortage of teachers and the importance of literacy and numeracy education in Lesotho as the primary reasons. Their primary concern regarding large-scale use was the probable cost implications. Administrators recommended a more extended pilot study with a larger and more varied sample of schools to assess the effectiveness of the aids. Both administrators and teachers stressed the role of the aids as only a supplement to classroom teaching. The preceeding observations suggest optimism with regard to effective large scale and long term use of the aids. However, the ORACLE study suggests that despite the strong Object, Authority and Environment dimensions, due to a weak Linkage dimension, Resources and a probable superficial Consensus dimension the chances of the use of the aids extending beyond the pilot stage were either moderate or none at all.

However, it must be stressed that these conclusions have been drawn from a brief exploratory study with a very small sample and over a very brief period. This suggests the need for a more extensive study in order to arrive at a more sound base to make decisions.

C H A P T E R   I V

CONCLUSIONS AND RECOMMENDATIONS

This study has concerned itself with the problem of
planning for the introduction of a technological innovation
for education in developing countries. The study highlights
the following aspects:

1. Application-Issues are the primary reason for the
considering of an innovation and hence need to be
examined initially.

2. Though application-issues are the primary reasons
for initial acceptance, it is the Organizational and
Long-Term Issues which are the decisive criteria in the
acceptance, installation and in sustaining the
innovation.

3. An exploratory study or a pilot study can provide
useful insights as to the futurity of an innovation in
a particular setting, that is, whether the
innovation will live or die in that setting.

Application issues revolve around features of a
technology such as its hardware capabilities and its
capability to perform the functions that it has been applied
to effectively. Organizational issues relate to factors
specific to a context such as its logistics, political and

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social considerations. Bodies of literature, representative
of projects involving technological innovations for
educational development, were reviewed in order to examine
how and to what extent organizational factors had affected
their performance. Theories and models of innovation
research over the last two decades were also reviewed, in
order to gain a theoretical perspective on the nature of
innovation introduction and adoption. A field study was
conducted to assess application, organization and long term
factors associated with the introduction of an innovation in
a developing country. The field study was an exploratory
study conducted in the Kingdom of Lesotho, Southern Africa,
to examine the viability of using electronic hand-held
devices for literacy and numeracy instruction. Tests were
conducted with the learners to assess the technical
feasibility and learning effects of the aids. These
constituted the application issues. Interviews and
observations were conducted with the pupils, teachers and
administrators to assess organizational and long-term
issues.

Conclusions drawn from the literature review and the
field based study are presented below, in summary.

Literature Review

The factors highlighted by the sample of technological
innovation projects reviewed were as follows:

1. government support or support is of paramount importance to any innovation project from the point of its inception to its execution and for its survival.

2. Participation at all levels is necessary for the smooth execution of the project.

3. In technology oriented projects, the human element is very critical for the acceptance and execution of the projects.

4. Integration of the innovation into the local culture is significant, if the innovation is to serve its intended function or even survive.

5. Planning ahead, prior to embarking on an innovation project, as well as during the pilot study is important. Ignoring this aspect leads to unsuccessful attempts or penalties in time and money for all concerned.

6. Training for possible new roles and responsibilities that might be created due to the use of the innovation is necessary for sustaining an innovation.

The review of innovation theories and models provided valuable insight in the progression into the process of innovation. Rogers, Katz, Miles and Hall focused on adoption whereas Rogers and Shoemaker, Havelock, Berman and McLaughlin and Lindquist on implementation. Subsequently Havelock and Huberman proposed a model for predicting the

generalization of innovations. The models represent an increase in the levels of synthesis over time and in the level of knowledge, possibilities and potential and in the extent of humanization of innovation theories.

Field Based Study

In terms of application issues the results seemed to point out clearly that the learning aids met the conditions of technical feasibility. The batteries in the aids lasted at least up to their specified life-time. The aids proved to be durable and the safety of the aids did not cause any concern. The technical characteristics of the aids, such as the voice and visual display, were satisfactory to the extent that most pupils could use them with ease. However problems regarding the accent, the mechanical voice and certain characters were mentioned by the users.

In terms of learning effects, the use of the aids suggested that pupil achievement both in English and Arithmetic were positive. The effects of the language aids were more pronounced, probably because they were used at a more appropriate grade level. The effects of the aids was stronger on the less able pupils. However significant gains were also made by the more able pupils using the aids. The results indicate that the learning aids indeed play a significant role in providing drill and practice.

In terms of organizational and long-term large scale
issues, pupils, teachers and administrators expressed
favorable reactions. Pupils were extremely enthusiastic
about the aids and cited the audio-visual and feedback
features of the aids as the principal factors for their
interest in the aids. Teachers and administrators
emphasized the contribution of the aids towards improving
literacy and numeracy instruction by providing drill and
practice as the principal reasons for their favorable
attitudes. Teachers and administrators also indicated that
the aids did not present any curricular conflict, though
they did upset the scheduling of classes due to the time
taken for distribution and collection of the aids. The
aids' facilitation of group work and enthusing the pupils to
learn were seen as positive features by the teachers.
Administrators indicated that favorable attitudes of
teachers and children and their perception of aids'
usefulness would be important factors in their decision to
use the aids in the future. Expenses involved in procuring
and maintaining the aids and the additional responsibility
of providing storage and safety for the aids, were viewed as
the major constraints in the long term, large-scale use of
the aids in Lesotho.

Some administrators however, were of the opinion that
if the benefits of using the aids could be positively
established, then costs could be made covered either by

soliciting funds from external agencies or by directing
funds from other activities.

Teachers and administrators alike, were of the opinion
that a much more extensive pilot study had to be conducted
before any well-founded decisions could be made regarding
the use of the aids.

The opinions of teachers and administrators and the
observations made during the field study were then examined
within the framework of Object, Resources, Authority,
Consensus, Linkage and Environment, in order to gain an idea
of the probable long-term, large-scale future of this
innovation in Lesotho. The application of the ORACLE
dimensions suggests that substantive efforts and major
changes in the infrastructure would be required for
sustained large scale use of this technology in Lesotho.
However, given the limited sample size and the external
support available to the project, these generalizations
should be considered, necessarily tentative.

<u>Recommendations</u>

This final section presents some recommendations
derived from the various aspects of this study. Two sets of
recommendations are presented--one, which is specific to
enhancing the use of learning aids in Lesotho and the other,
which is general for planners involved in the process of

introducing technology for educational development in developing countries.

Learning-Aids

1. Efforts need to be made to modify the technical characteristics of the learning aids to make them more adaptible to the context of Lesotho. The modifications should include:

    a. an improvement in the voice quality to make it more human-sounding.

    b. programming the aids with words drawn from the local language or from the local version of English and to use the symbols used locally.

    c. programming the aids to allow more control over difficulty levels to accommodate different skill levels.

    d. finding alternative power sources such as rechargeable or solar batteries, which would help reduce costs.

2. Extensive follow-up research should be conducted in order to gain a better understanding of the effects of the aids and derive factors that would enhance their use-potential. Such follow-up research should be directed towards investigating the following areas:

    a. the appropriate grade levels where the use of the aids is most productive.

b. the relative impact of the aids in rural
schools as against urban schools and the
differences in the nature of intervention and use,
if any, between these two sectors.

c. the consequences of using the aids over time
and possible mechanisms to address any negative
consequences.

d. the effects of using the aids under normal, non-pilot
study conditions.

e. the length of time, the sequence of
instructional routines, nature of teacher inputs
and support materials that would enable the use of
the aids to be well linked to the normal
activities of a school and be effective.

3. In case of extensive implementation, planning must
be done to devise effective strategies for the use of
aids. Some of the steps that could be taken in this
direction are:

a. formulation of a system of training of
teachers in ways to use the aids effectively in
their classroom. Such training would be based on
consolidated results from an extended pilot study
which provides information on the factors
mentioned earlier. The training could be provided
by the set of teachers who have had previous

exposure, during the pilot study or the
exploratory study.

b.   devising a system of rotation of learning aids
between schools. Apart from decreasing the time
away from regular activities, such a step could
help reduce the overall costs of learning with the
aids.

c.   develop a system of monitoring the use of the
aids (whether time schedules are being adhered
to), their safety and to ensure that rotation
schedules are being adhered to.

d.   set up schedules in schools in order that
there is minimum disruption of other classroom
activities.

4.   The use of the learning aids in conjunction with
other readily available media should be experimented
with, in order to see if a combination of media could
serve the needs of education in Lesotho's primary
schools more productively.

Planning

The following list proposes several recommendations
for planners and practitioners involved in introducing and
implementing innovations in developing countries.

1.   The first of these recommendations revolves around
the Object dimension. Planners need to evaluate the

needs of a particular context very carefully, prior to
considering an innovation. Similarly the relevance of
the innovation to the needs should also be assessed with
utmost care. This is especially true of
innovations involving high technology, since the
extent of disruption, dislocation and wastage of
resources in the case of a misfit could be enormous.

2. The sanction of governments, ministries, and top
officials must be ensured prior to embarking on an
innovation project. While in most cases, such a
sanction is an apriori requirement, it should be
ensured, to the extent possible, the sanction is well
qualified and consistent over the period of the
project.

3. The planning function should ensure participation
at all stages of the innovation process. The opinions
of participants at all levels, and not merely the top
officials, should be incorporated from the initial
stages of need identification, selection, development
and introduction of the innovation.

4. The planning function must take steps to ensure that
neither the innovation nor its process of
introduction is in conflict with social and cultural
values of the receiving society. A concomitant issue
is that of complexity. The innovation and information
about it should be in a form that is easily understood

by the users, in order that they are in a position to provide reasonable judgments about it.

5. The planning mechanism should incorporate features that will allow the integration of the innovation into the local culture and power structure at the earliest point in time that is deemed practical.

6. In introducing innovations, planners should consider the appropriateness of the timing of the introduction.

7. Innovation planners should recognize that the mutual interaction of the innovation and the adopter could alter the nature of the innovation as well as require changes in the adopter. Planning mechanisms should be able to anticipate and detect such changes and seek means to address them. In the case of the innovation, modifications in the original form of the innovation might be required. In the case of the adopters, training user for new skills, change in roles and addressing concerns may be required.

8. The process of planning for innovations should preserve a balanced perspective regarding innovation characteristics and the contextual parameters. Ignoring either leads to a lop-sided focus in the innovation introduction process.

9. Planners need to assess factors that would affect the long-term large-scale effects to the extent

possible and potential of the innovation at the
introductory or pilot stage itself. This is essential
as the results of a pilot study cannot be scaled up
for a more extensive application of the innovation in
all cases.

10. Planners should have a realistic expectation of
the technology or the innovation based on a thorough
understanding of the technology and the context that
it is being applied in. Overpromising the benefits of
an innovation leads users to have expectations that
cannot be realized and consequently disenchantment
with the innovation. In this respect, it must be
pointed out that the termination of an innovation
project could itself be considered as a success of the
innovation.

Concluding Remarks

This study has examined planning issues relating to
the introduction of a technological innovation for education
in developing countries and sustaining the innovation.
Literature on representative innovation projects as well as
theories and models of innovation research have been
reviewed. A field study was conducted to study the
introduction of an innovation in a developing country, in
order to assess its feasibility in that context and to
derive the factors affecting the introduction and future use

of the innovation. The field study involved the use of electronic hand-held learning aids to supplement literacy and numeracy instruction in Lesotho, Southern Africa.

Conclusions, implications and recommendations were derived from the study, for innovation planners and practitioners. A balance between an <u>Organizational focus</u> and an <u>Application focus</u> in planning as well has a consideration of long-term, large-scale aspects during the introductory phase, were recommended as being critical to innovation projects.

It is hoped that the results of the study will be useful, for this particular innovation, in case it is pursued in Lesotho or introduced in other developing countries. It is also the hope of this researcher that the general recommendations proposed will be useful for future planning exercises.

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APPENDIX A

Test School Profiles,

Test Population and

Treatment Data

School: O.B. Collins

Location: Rothe

Proprietor: African Methodist Church

Total
 Enrollment: 365

Pass Rate: 50%
PSLE 82

Fees: M 49

Environment: Rural

Facilities: Fair to Good--concrete floor, corroguated
                 iron roof, adequate space and furniture,
                 blackboards

Treatment: Language--4 weeks beginning 31 October

Class: Standard 4

Enrollment
 in Test
  Class: 31 Pupils

Teacher: Mr. Thabo Maimane, Certificate JC, LOS 1 year

Class: Standard 3

Enrollment
 in Test
  Class: 44 pupils

Teacher: Mrs. Mpakeleng Matlali, Certificate COSC, LOS
                 3 years

Head Teacher: Mrs. M. Setlai

APPENDIX B

Stages of Concern Questionnaire

Definitions of Stages of Concern

SoC Questionnaire Items

0 = Irrelevant

1 2 3 = Not true of me now

3 4 5 = Somewhat true of me now

5 6 7 = Very true of me now

1. I am concerned about students' attitudes towards this
    innovation.

    0 1 2 3 4 5 6 7

2. I now know of some other approaches that might work
    better.

    0 1 2 3 4 5 6 7

3. I don't even know what the innovation is.

    0 1 2 3 4 5 6 7

4. I am concerned about not having enough time to organize
    myself each day.

    0 1 2 3 4 5 6 7

5. I would like to help other faculty in their use of the
    innovation.

    0 1 2 3 4 5 6 7

6. I have a very limited knowledge about the innovation.

    0 1 2 3 4 5 6 7

7. I would like to know the effect of reorganization on my
    professional status.

    0 1 2 3 4 5 6 7

8. I am concerned about conflict between my interests and
    my responsibilities.

    0 1 2 3 4 5 6 7

9. I am concerned about revising my use of the innovation.

   0 1 2 3 4 5 6 7

10. I would like to develop working relationships with both our faculty and outside faculty using this innovation.

    0 1 2 3 4 5 6 7

11. I am concerned about how the innovation affects students.

    0 1 2 3 4 5 6 7

12. I am not concerned about this innovation.

    0 1 2 3 4 5 6 7

13. I would like to know who will make the decisions in the new system.

    0 1 2 3 4 5 6 7

14. I would like to discuss the possibility of using the innovation.

    0 1 2 3 4 5 6 7

15. I would like to know what resources are available if we decide to adopt this innovation.

    0 1 2 3 4 5 6 7

16. I am concerned about my inability to manage all the innovation requires.

    0 1 2 3 4 5 6 7

17. I would like to know how my teaching or administration is supposed to changed.

    0 1 2 3 4 5 6 7

18. I would like to familiarize other departments or persons with the progress of this new approach.

    0 1 2 3 4 5 6 7

19. I am concerned about evaluating my impact on students.

    0 1 2 3 4 5 6 7

20. I would like to revise the innovation's instructional approach.

   0 1 2 3 4 5 6 7

21. I am completely occupied with other things.

   0 1 2 3 4 5 6 7

22. I would like to modify our use of the innovation based on the experiences of our students.

   0 1 2 3 4 5 6 7

23. Although I don't know about this innovation, I am concerned about things in the area.

   0 1 2 3 4 5 6 7

24. I would like to excite my students about their part in this approach.

   0 1 2 3 4 5 6 7

25. I am concerned about time spent working with nonacademic problems related to this innovation.

   0 1 2 3 4 5 6 7

26. I would like to know what the use of the innovation will require in the immediate future.

   0 1 2 3 4 5 6 7

27. I would like to coordinate my effort with others to maximize the innovation's effects.

   0 1 2 3 4 5 6 7

28. I would like to have more information on time and energy commitments required by this innovation.

   0 1 2 3 4 5 6 7

29. I would like to know what other faculty are doing in this area.

   0 1 2 3 4 5 6 7

30. At this time, I am not interested in learning about this innovation.

    0 1 2 3 4 5 6 7

31. I would like to determine how to supplement, enhance, or replace the innovation.

    0 1 2 3 4 5 6 7

32. I would like to use feedback from students to change the program.

    0 1 2 3 4 5 6 7

33. I would like to know how my role will change when I am using the innovation.

    0 1 2 3 4 5 6 7

34. Coordination of tasks and people is taking too much of my time.

    0 1 2 3 4 5 6 7

35. I would like to know how this innovation is better than what we have now.

    0 1 2 3 4 5 6 7

Definitions of Stages of Concern

0. Awareness   Little concern about or involvement with the innovation is indicated.

1. Informational   A general awareness of the innovation and interest in learning more detail about it is indicated. The person seems to be unworried about himself/herself in relation to innovation. She/he is interested in substantive aspects of the innovation in a selfless manner such as general characteristics, effects, and requirements for use.

2. Personal   Individual is uncertain about the demands of the innovation, his/her inadequacy to meet those demands, and his/her role in relation to the reward structure of the organization, decision-making and consideration of potential conflicts with existing structures or personal commitment. Financial or status implications of the program for self and colleagues may also be reflected.

3. Management   Attention is focused on the processes and tasks of using the innovation and the best use of information and resources. Issues related to efficiency, organizing, managing, scheduling, and time demands are utmost.

4. Consequence   Attention focuses on impact of the innovation on students in his/her immediate sphere of influence. The focus is on relevance of the innovation for students, evaluation of student outcomes, including performance and competencies, and changes needed to increase student outcomes.

5. Collaboration   The focus is on coordination and cooperation with others regarding use of the innovation.

6. Refocusing   The focus is on exploration of more
                          universal benefits from the innovation,
                          including the possibility of major
                          changes or replacement with a more
                          powerful alternative. Individual has
                          definite ideas about alternatives to the
                          proposed or existing form of the
                          innovation.

APPENDIX C

Questionnaires for Interviews with

Pupils, Teachers and Administrators

Interview with Pupils

Comments on the process are within brackets [ ].

Name: Age: Sex:

[Show the aids to the pupil]

1. What is/are these? What are their names?

2. What subjects do they help you in?

    Subject

    Number

3. Do you like using these aids?

    Yes

    No

    Indifferent

4A. What do you like most about these aids?

4B. What else do you like about the aids?

4C. Do you like the aids because

    a) they speak?

    b) they are easy to hold?

    c) they are easy to read?

    d) the words are easy?

    e) the arithmetic problems are easy?

    f) they help you understand English words better?

    g) they help you do arithmetic better?

    h) any others?

5. What do you like least about the aids? Why?

6A. Are the words that the aids give you

    too easy or

    too difficult

    or about right

6B. Are the problems that the aids give you

    too easy or

    too difficult

    or about right

7. Can you understand the pronunciation of the aids when they speak to you?

    Yes

    No

8. Can you hear the aids without difficulty when using it in the classroom?

    Yes

    No

9A. Is understanding the pronunciation and hearing the aids better now than in the beginning?

    Yes

    No

9B. Which exercises have you done in the Speak & Read/Speak & Math?

10A. What is your favorite exercise in the Speak & Read?

10B. Why?

11A. Which exercise do you like best?

11B. Why?

12. How many people are in the group you work in?

13. Do you think that the number of people in the group is

    a. too much

    b. too few

    c. just right

14. Do you get to use the aids as much as everyone else in the group?

    Yes

    No

15. Do other people in the group help you when you are using the aids?

    Yes

    No

16. Do you help them?

    Yes

    No

17. When using the aids in a group, do you say the answer and press the buttons or does the group say the answer and you press the buttons?

18. Do you prefer to work by yourself with the aids or with a group?

    Group

    Alone

19. Do you like keeping scores when working with the aids?

    Yes

    No

20A. Are you satisfied with the amount of time that you use the aids now?

    Yes

    No

20B. Would you like more time?

    Yes

    No

20C. Would you like less time?

    Yes

    No

21. If it were possible, would you use the aids during breaks or after school hours?

    Breaks

    After School

22. What does your teacher do when you are working with the aids?

23. Do you call him/her for help when you have a problem?

    Yes

    No

24. What would you like your teacher to do when you are using the aids?

25A. Do you like taking the tests?

    Yes

    No

25B. If yes, why?

25C. If no, why?

25D. Do you recognize words and problems in the tests that
     you have seen in the machines?

     Yes

     No

26. Are you getting tired or bored of the aids?

     Yes

     No

27A. Are the aids helping you to do arithmetic better?
     [Speak & Math]

     Yes

     No

27B. Are the aids helping you know and understand English
     works better?

     Yes

     No

28. Do you think that it would be a good idea that other
     children, in your school and elsewhere, to be using
     these aids?

     Yes

     No

29. Can you think of anything that you would want to change
     in the learning aid or its use?

Interview with Teachers

1. Do you find the machines (aids) useful?

   Yes

   No

   If yes, how?

   If no, why?

2. What problems do you see with

   a) the machines?

   b) their use?

3. Do you feel that the children adjusted easily to the machines?

   Yes

   No

4. Does the material presented by the machines support what is normally taught in the classroom?

   Yes

   No

   If yes, how?

   If no, how?

5. Do you feel that teachers would require major retraining to use these machines on a large scale?

   Yes

   No

6A. Will the use of the aids upset your normal school operations?

Yes

No

   i) in terms of curriculum

  ii) scheduling

6B. If yes, how?

 7. Do you feel the children are prepared, culturally, to use these aids and learn from them?

    Yes

     No

 8. At which level (standard) do you feel that the use of the aids could be most beneficial?

    Standard

    Non-Standard

 9. Does the use of the machines cause any discipline problems in class?

    Yes

     No

10A. Do you feel that children could be left unsupervised while using these machines?

    Yes

    No

10B. If yes, at what standards?

11A. Do you think that the accent in the machine is a problem?

    Yes

     No

11B. Do you think that understanding the accent is easier
now than in the begininng?

Yes

No

11C. Assuming the accent is a problem, do you think that it
is worthwhile to invest more to change the accent?

Yes

No

12. Do you feel it is more preferable to use these aids for
English or Sesotho?

English

Sesotho

13. Do you feel that the amount of time that the machines
are being used now is

a. too little

b. too much

c. about right

14. What are the major reasons for not using the machines
on scheduled days/times?

15A. What do you think should be the size of the groups
using the aids?

Size

Number

15B. Do you think that the children in the groups are being

a. cooperative

b. competitive

16. Do you think it is preferable to use the aids

   a. in groups

   b. individually

17. For the amount of time the aids are used, do you think the extent of matters covered as compared to regular teaching is

   a) less

   b) more

   c) about the same

18. What is the best thing about the aids?

19. What is the worst?

20. Do you think that children would soon get bored of the aids?

   Yes

     No

   Younger

   Older

21A. What do you think the children like most about the aids?

21B. What do you think the children like least about the aids?

22. Do you feel that children will start losing respect for the teachers because of the machines?

   Yes

   No

23. Do all the teachers in your school know how to use the machines?

   Yes

   No

24. What do they feel about the machines?

25. Do they want it in their classes?

26. Do you think children should be allowed to take the machines homes?

   Yes

   No

27. Do you think it would be better to use these machines at home for practice/drill or in school?

   Home

   School

28. How do you feel the teachers role/function changes with the use of the machines?

29. Do you think the aids would allow teachers to give more individual attention to children?

   Yes

   No

30. Do the parents of the children know about the aids?

   Yes

   No

31. Do you know what they feel about the use of these aids?

   Yes

   No

32A. Do you feel all schools should have these aids?

Yes

No

32B. Do you feel all classes should have these aids?

Yes

No

33. What subjects, do you feel, would these aids be most useful in teaching?

34. How did you feel about the aids in the beginning?

35. How do you feel about them now?

36A. Do you feel that the aids are easy to use?

Yes

No

36B. How do you feel teachers could improve the use of the aids?

37. If your school had to buy the aids, do you see them as being useful enough to pay for them?

Pay entirely?

Subsidized?

38. Do you think the aids will be more useful in rural schools or urban shools?

Rural

Urban

Why?

Interview with Educational Administrators

Name: Title/Position:

1. In your opinion, do/can the use of any audio visual
    aids supplement or help improve education?

    Yes

    No

2. In your opinion, how important is the role of drill and
    practice in a) language and b) arithmetic.

    a. Language: b. Arithmetic:

        High   High

        Medium   Medium

        Low   Low

3. Have you had a chance to see the electronic learning
    aids?

    Yes

    No

4. Have you had a chance to see the aids being used in a
    class?

    Yes

    No

5. Do you think that the use of these aids will supplement
    or help improve education?

    Yes

    No

6. Do you think that these aids will help children with drill and practice?

    Yes

    No

7. Do you think a mechanical device is worth being considered to explore its use in improving education?

    Yes

    No

8. What was your response when you first heard that these electronic aids were going to be tested in Lesotho? (Briefly.

9. How would you rate the following in terms of their importance in deciding whether these aids should be used?

VI = Very Important

MI = Moderately Important

NI = Not Important at all

	VI	MI	NI
1. Teachers like the aids			
2. Children like them			
3. Teachers feel that they are useful			
4. Students feel that they are useful			
5. Scores show they improve language learning (tests)			
6. Scores show it improves arithmetic learning (tests)			
7. Curriculum developers like them			

    8.   Administrators like it

    9.   The cost of the aids

   10. They do fit into the curriculum

   11. They do not upset normal school
       operations (classes, subjects,
       etc.)

   12. They are durable

10. Do you think it is more important for the aids to teach using Sesotho or English?

   Sesotho

   English

11. Given the fact that there are undertrained teachers in Lesotho, do you think aids like these would be:

Very useful   Moderately useful   No difference

Reasons:

12. Given the fact that teacher aids are scarce and expensive, do you think aids like these would be:

Very useful   Moderately useful   No difference

Reasons

13. Given teacher absentism, do you think aids like these would be:

Very useful   Moderately useful   No difference

Reasons:

14. Given that drill and practice is a mechanical task which teachers would find boring, do you think aids like these would be:

Very useful   Moderately useful   No difference

Reasons:

15. Do you think that these aids would be more effective if they used local word lists and speakers?

  Yes

  No

16. Given that adaptations to use local word lists and speakers would make the aids more expensive, would they still be worthwhile?

   Yes

   No

17. If the present pilot study indicates that scores improve and that teacher and student attitudes are favorable, which of the following would you consider as the next best step:

a) Introduce the aids in some more schools
    and test the effect

b) Introduce them to all schools in a district

c) Introduce them on a national level

d) Try them in another country

e) Discard their use totally

*Reasons overleaf

18. How do you think these aids would fit <u>best</u> in the existing curriculum in schools?

a) As a supplement for all for drill and practice

b) For remedial learning for weaker students

c) To keep better students occupied while
   teachers help the weaker ones

d) Any others; (please list)

18A. How do you think these aids would fit best in the
     existing school day?

a) Use them in the regular English and Math classes

b) Use them in the children's recess

c) Use them after school

d) Use them at home and not in school

e) Any others; (please list)

19. If these aids were to be used in a developing country
    (such as Lesotho) how would you rate the following
    factors in terms of being obstacles in large scale use.
    (Please give reasons wherever relevant.)

    SCALE: D = Difficult; M = Manageable; DBW = Difficult
    But Worthwhile; E = Easy; NO = Not an Obstacle at all

                                        D M   DBW E   NO

    1. Initial Procurement costs

    2. Maintenance lists (recurrent:
        battery expenses, replacements,
        storage)

    3. Retraining of teachers

    4. Rescheduling of school
        operations (classes,
        periods, etc.)

    5. Parents' attitudes towards use

6. Teachers' attitudes towards use

7. Children's attitudes towards use

8. Administrators' attitudes
   towards use

9. Ability to develop materials to
   support the use of these aids

10. Issues of maintenance; storage,
    breakage, replacements,
    batteries, etc.

11. Ability to provide the aids
    to all schools

12. Projected size of school
    enrollments

13. Ability to evaluate if the
    aids are really useful

14. Schools' ability to continue
    use of these aids over time

15. Any others (Please list)

APPENDIX D

Coding Form for

Spot Observations

Coding Form

Pupil   Sex   School   Standard

Lesson: Maths   Language   Lesson Type   Date:

Context of Lesson   In   Out

Size of Group: 3   4   5

Length of Treatment: 12   8   4

                                    1   2   3   4   5   6   7   8   9   10

I.   Behaviors

    A.   Engaged

        1.   Manipulating

        2.   Attending

    B.   Not Engaged

        1.   Non-Attending

        2.   Doing Other Task

        3.   Out of Lesson

    C.   Disruptive

        1.   Interferes w/Aid

        2.   Interferes w/Others

    D.   Transition

        1.   Passing Aid

        2.   Teacher Directions

        3.   Waiting

II. Emotional Tone

    A.   Low

    B.   High

Summary   Behaviors

Tone	Engaged		Not Engaged			Disruptive		Transition			Total
	1	2	3	4	5	6	7	8	9	10	
Low											
High											
Sub-Total											
Total											

 1 = Manipulating

 2 = Attending

 3 = Non-Attending

 4 = Doing Other Task

 5 = Out of Lesson

 6 = Interfers w/Aid

 7 = Interfers w/Other

 8 = Passing Aid

 9 = Teacher Directions

10 = Waiting

APPENDIX E

Weekly Improvement of

Test Scores of

Participating Classes

Weekly Improvement of Test Scores
of Participating Classes
(Expressed in Standard Deviation Units)

Language

Hoohlo - Standard 4 (12 weeks)

Test	Instructed	Non-Instructed
2	.27	.24
3	.53	.68
4	.33	.48
5	.76	.15
6	.31	.54
7	.59	-.21
8	.38	.44
9	.93	1.13
10	1.36	.74
11	1.38	1.17

Masspong - Standard 4 (8 weeks)

2	.99	.86
3	1.10	1.06
4	.47	.53
5	1.10	.50
6	-.05	.41
7	.81	.27
8	.60	1.30
9	1.40	1.59
10	1.60	1.23
11	1.40	1.35

O.B. Collins - Standard 4 (4 weeks)

2	1.56	.88
3	1.16	1.60
4	.68	.67
5	.96	.47
6	-.21	.93
7	.72	-.70
8	.58	.79
9	2.34	1.68
10	1.96	1.15
11	1.70	1.72

APPENDIX F

Graphs of

Weekly Improvement

in Test Scores

HOOHLO

INSTRUCTED   NON-INSTRUCTED

MASAPONG

INSTRUCTED   NON-INSTRUCTED

O.B. COLLINS IV

INSTRUCTED   NON-INSTRUCTED
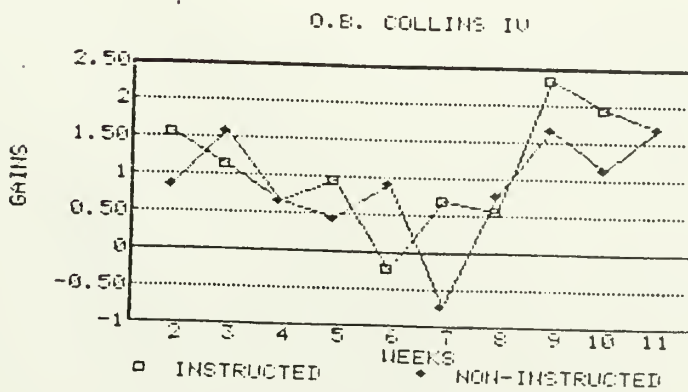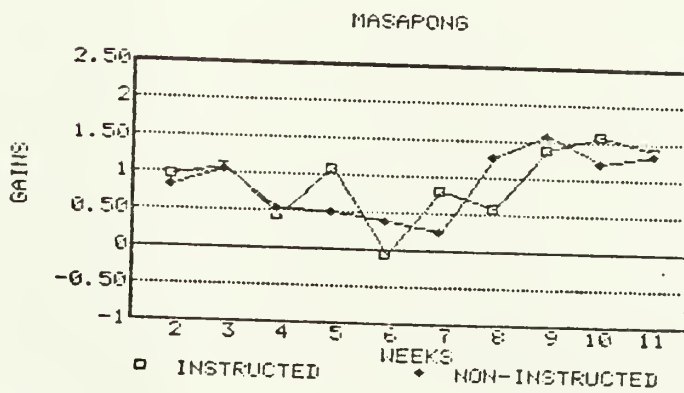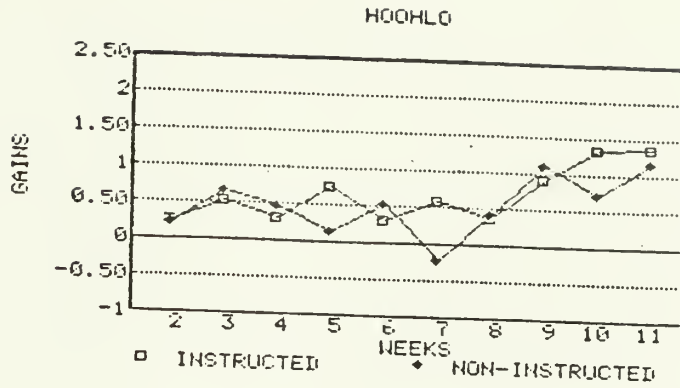
APPENDIX G

Weekly Improvement

of Each Test Class

in Standardized Scores

Arithmetic

Iketsetseng - Standard 6
(12 weeks)

Test	Score
2	-.29
3	.43
4	.67
5	-.09
6	-.21
7	.21
8	.62
9	.90
10	1.16
11	.85

Morija - Standard 6 (8 weeks)

2	-.10
3	.83
4	.65
5	.20
6	.13
7	.27
8	.66
9	1.08
10	1.37
11	.98

Hoohlo - Standard 6 (Control)

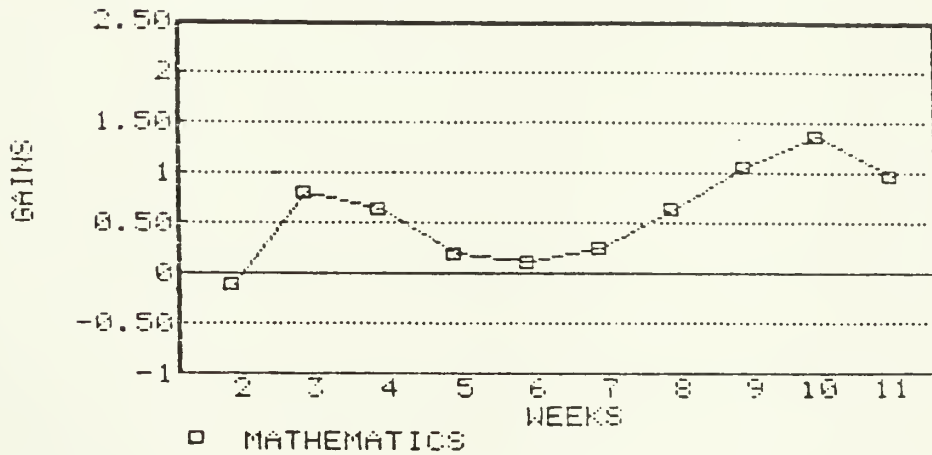|	
2	.05
3	.61
4	.69
5	-.06
6	-.29
7	.26
8	.65
9	.48
10	.83
11	.62

APPENDIX H

Graphs of Weekly Improvement

of Each Test Class

in Standardized Scores

IKETSETSENG

MORIJA — STANDARD 6

HOOHLO — STANDARD 6