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ELECTRONIC AIDS IN A DEVELOPING COUNTRY: IMPROVING BASIC SKILLS IN LESOTHO

Electronic Aids for Literacy Project

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In collaboration with:

The Lesotho Distance Teaching Centre

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The Lesotho National Curriculum Development Centre

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EXECUTIVE SUMMARY

The present study reports on the design, execution, and results of a field test of electronic learning aids in five primary schools in the Kingdom of Lesotho. This test was conducted with the collaboration of the Lesotho Distance Teaching Centre and the National Curriculum Development Centre. 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. Some 509 children participated in the test, either by using the aids or serving as control subjects. The aids were used by pupils working in groups of four for one hour per day, two to five times per week during the appropriate classroom time for English or arithmetic.

Purpose

The purpose of the field test was to determine whether the use of existing model of electronic aids is feasible in primary schools in a developing country like Lesotho, how the aids fit into the structure and processes of the classroom, and whether pupils' mastery of English and arithmetic is strengthened by use of the aids.

It was hoped that the field test would shed light on the usefulness of existing models of devices like the Speak and Read and Speak and Math and, if necessary, suggest modifications required to make them more appropriate or effective for instruction in developing countries.

Procedures

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. There were control classes for both English and arithmetic. Pupils were tested weekly for eleven weeks on either English word recognition or arithmetic. Classrooms were visited weekly for general observation and for a more structured analysis of pupil behavior with the aids. Interviews were conducted with pupils, teachers, and officials responsible for curriculum in Lesotho.

Results

The results of the twelve-week field test of the Speak and Read and the Speak and Math in five primary schools in Lesotho demonstrates the feasibility of using electronic aids to support school instruction in developing countries.

Specific results in the three main areas of investigation include the following:

1. Technical Feasibility - The study concludes that electronic aids can be introduced into primary schools in a developing country without great cost and preparation. The aids stood up well mechanically to classroom use. Only a few required replacement, and none was lost because of poor house-keeping on the part of the teachers. Pupils showed themselves able in adapting quickly to the synthetic speech contained in the aids.

2. Human Use Effects - Interviews conducted with teachers, administrators, and pupils indicated a widespread belief that the aids were useful. The result of pupil observation showed a high degree of involvement during the periods when the aids were used. Both the interviews and observation demonstrated that it was feasible to use electronic aids in groups of four.

3. Learning Effects - The results of weekly test of pupils' English word recognition and arithmetic demonstrated positive learning effects associated with use of the aids. For both language and arithmetic, pupils using the aids showed greater gains in achievement than those not using the aids. In both cases, the differences were statistically significant. Despite expectations, the impact of the aids on achievement was higher for language than arithmetic. The study showed the aids had a greater impact on learning among the less able pupils. No differences in achievement were discovered between boys and girls using the aids.

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Chapter I

INTRODUCTION

Throughout the past twenty years, the priority placed by developing countries on the development of primary school education has not wavered. Developing countries affirmed their commitment to the rapid expansion and qualitative improvement of primary education at regional conferences held during the 1960's in Addis Ababa, Tripoli, Santiago, and Karachi. The importance assigned to primary school education has been reaffirmed on countless occasions in international forums and in national educational policies.

Despite the remarkable growth of primary school education during the past twenty years, serious deficiencies remain in systems throughout the world. As expenditures for primary education as a proportion of total government spending have been stretched to a limit in many places, countries find that their investments have not yielded the expected returns. The size of classes is often too large; the number of undertrained teachers is still too high; large disparities exist between educational opportunities for rural and urban youth; books and other materials remain scarce; and the prospects for many children to go beyond the first few grades of school are often dim.

Failures at the early primary level are of special concern. For the many children who leave school after the first few grades, inadequate skills in reading, writing, and arithmetic will be difficult to retain as the young school leavers begin to look for work or learn a trade. For those continuing in school, failure to acquire basic skills in the early years becomes compounded in succeeding ones.

Much of the overall weakness of educational systems in developing countries stems from weaknesses at the early primary level. The necessity of effective teaching is probably greatest during the first few years of school. But it is here that teachers in developing countries are most likely to be undertrained, unprepared for the complex tasks of instruction in the basic skills, and overburdened with too many students and too few materials.

Few developing countries today are escaping the pressures of rapid population growth, economic recession or stagnation, and monetary inflation. For a labor-intensive enterprise like primary education, this means that most countries can expect their primary school system to be increasingly required to produce more education with fewer resources.

In many places, the future image of the self-contained, properly equipped classroom, with a well-prepared teacher, thirty pupils and a sufficient supply of textbooks and other instructional materials will be an illusory one. Developing countries will be forced to give greater consideration to alternative approaches to delivering education. As teachers find themselves able to provide progressively less for each pupil, new and cost-effective ways must be found to improve instruction in the context of large classes.

In few places will it be possible to anticipate improvements in education without a greater and more careful application of technology to education. For primary schools in developing countries, two of the most promising possibilities at the moment are radio -- the potential of which is already established -- and the microprocessor-driven learning aid -- the feasibility of which was addressed for the first time by this experiment.

Project Background

As part of a continuing effort to find new ways to assist developing countries strengthen literacy instruction, the Center for International Education (CIE) spent a year informally exploring the advisibility of, and interest in, using hand-held electronic aids to supplement school instruction. A substantial exchange of ideas took place with educators from developing countries and with the manufacturer of some of the most widely-used electronic aids, Texas Instruments, Inc.

This dialogue resulted in a proposal entitled "An Experimental Approach to the Use of Electronic Aids in Developing Countries." The unsolicited proposal was submitted to the Office of Education, Bureau for Science and Technology of the U.S. Agency for International Development. A grant from this Office and a donation of equipment from Texas Instruments, Inc. permitted establishment of the Electronic Aids for Literacy Project. The Project operated between June 1983 and March 1984.

The major part of the Project's scope of work involved a field test of electronic learning aids in five primary schools in the Kingdom of Lesotho. This test was conducted with the collaboration of the Lesotho Distance Teaching Centre and the National Curriculum Development Centre. 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. Some 509 children participated in the test, either by using the aids or serving as control subjects. Teachers were asked to use either the Speak and Read or the Speak and Math for one hour two to five times per week whenever it was convenient to schedule the

time. The pupils using the arithmetic aid were in Standard 6 (11-13 years old); those using the language aids were in Standards 3 and 4 (8-10 years old).

In addition to the field test of the electronic aids in schools, the Project investigated the use of electronic aids with one out-of-school learning group and experimented with some educational applications of micro-computers. These activities are described in other reports.

The Learning Aids

The field test in Lesotho made use of two electronic aids manufactured by Texas Instruments, Inc., the Speak and Read and the Speak and Math. These aids provide drill and practice in English and arithmetic.

The aids make use of a three-chip system for synthesizing human speech. Consisting of a speech synthesizer, read-only memory, and controller, the system is based upon a voice-compression technique called linear predictive coding. The synthetic speech system is linked to an eight digit alpha-numeric florescent display and a keyboard.

The aids weigh just over one pound and operate on four "C" cell batteries. The aids cost about $30-$40 in retail stores in the United States.

The Speak and Read provides practice in phonics, sight vocabulary, and reading comprehension at levels of difficulty up to the U.S. third grade level. The aid gives practice with about 250 of the most basic English words. There are six different game routines - "Word Zap," "Hear It," "Letter Stumper," "Picture Read," "Read It," and "Word Maker." The aid contains three levels of difficulty for some of the routines. The Speak and Read

is expandable by insertion of one of eight available plug-in modules, each containing about 200 new words.

Speak and Math offers arithmetic drill at levels of difficulty ranging from first to sixth grade. There are five different instructional routines "Solve It," "Number Stumper," "Write It," "Greater/Less Than," and "Word Problems." The Speak and Math provides up to 100,000 different problems, generated randomly, at three levels of difficulty. The levels of difficulty are usually based on the number of digits in the problems presented by the aid.

The pronunciation of the English words contained in these models suggests that they were designed for a North American audience. There is a "British" English version of the Speak and Math but not for the Speak and Read.

Resources and the focus of the field test in Lesotho did not permit a testing of the Speak and Spell learning aid. The specifications for (both of) the aids used are contained in Appendix A-1.

Pedagogical and Cost Assumptions

Whether electronic learning aids will one day prove to be a cost-effective addition to primary school education in developing countries will depend on decisions about whether the benefits are worth the costs. This relationship will depend to a large extent on how the learning aids are used in the classroom and the value assigned to the kind of instruction offered by the aids.

A set of assumptions guided the way that the aids were used and tested in Lesotho. They are the following:

1. Drill and practice is important for the acquisition and retention of basic skills. Teachers -- for a variety of reasons, some philosophical, some practical -- are often unable or unwilling to provide sufficient drill and practice in arithmetic and reading/language instruction. Computers have already proved themselves effective in providing drill and practice in school instruction, especially at the primary level. (1)

2. Immediate, individual feedback is important for learning. This essential instructional element tends to diminish as class size increases. Electronic learning aids are capable of providing such feedback.

3. Research has conclusively demonstrated that pupils often learn more effectively when working in groups than they do through more traditional didactic methods. (2) The cost of electronic aids dictates group use in most developing countries. Group, rather than individual use should be considered an asset and not a limitation.

4. Preliminary testing in The Gambia and in Lesotho indicated that pupils found electronic learning aids enjoyable to use. If the enjoyable nature of using electronic aids results in an increase in the amount or quality of time spent on instruction, eventual increases in achievement can be expected, whether or not gains are discernible during a pilot study.

5. It is not necessary for every school to own a set of learning aids. A system of rotating aids among grades and schools would greatly reduce the cost of this technology. If the aids were used as they were in Lesotho, in groups of four and rotated among schools, and if the aids last for 720 hours before needing replacement, this would result in a per pupil expenditure of $.94 for 60 hours of interactive drill in skills essential for arithmetic and reading.

In sum, it seemed reasonable to assume that electronic learning aids, in their present or modified form, may possibly offer cost-effective supplement to primary school education in developing countries and that an empirical testing of the aids in actual school settings was of practical importance.

References

1. There is a substantial body of literature on this question. An annotated bibliography of articles on the subject of the effectiveness of computer-assisted instruction for basic skills was prepared for AID by the Project.

2. For a good discussion of this research, see Jernstedt, G.C. "Computer Enhanced Collaborative Learning: A New Technology for Education," Technological Horizons in Education, May 1983, pp 96-101.

Chapter II

THE FIELD TEST

With the cooperation of the Lesotho Ministry of Education, the Lesotho Distance Teaching Centre, the Lesotho National Curriculum Development Centre, and five primary schools, a twelve-week field test of electronic aids was conducted in Lesotho. The field test was undertaken between September and December 1983.

Purpose

The purpose of the field test was threefold: to determine whether the use of existing models of electronic aids is feasible in primary schools in a developing country like Lesotho, how the aids fit into the structure and processes of the classroom, and whether pupils' mastery of English and arithmetic is strengthened by use of the aids.

By shedding light on the usefulness of existing models of Speak and Read and Speak and Math, it was hoped that the field test might also suggest modifications required to make them more appropriate or effective.

Feasibility, in the present exercise, means several conditions must be satisfied: that electronic learning aids can be introduced into the classroom without great cost, time or resistance; that the voice visual display, keyboard and game format of the aids are comprehended by pupils; that the aids can stand up mechanically to conditions found in the classroom and be kept safely by the schools; that teachers and pupils can use them efficiently and find them useful; and that the learning effects associated with use of

the aids appear to be positive or would be positive if used in a different way.

The Context of Primary Education in Lesotho

The Kingdom of Lesotho, mountainous and picturesque, is one of Africa's smallest countries. Independent since 1966, Lesotho lies entirely surrounded by the Republic of South Africa. With a population of just over one million people, Lesotho's economy is largely based upon agriculture and income received from Basotho miners working in South Africa.

Because of an extensive system of primary schools, Lesotho has one of the highest rates of literacy in Africa. Primary school education in Lesotho operates as a kind of partnership between the Government and the three leading Christian churches in the country. The 1000-plus primary schools enroll about 270,000 children. In 1980, this reflected 85% of the girls and 60% of the boys aged six to twelve. After completion of Standard 7, pupils sit for the Primary School Leaving Examination, which determines admission to secondary school. About half of those completing primary school do not proceed to secondary school.

The primary school curriculum consists of Sesotho, English, mathematics, social studies, science/health, and practical studies. In most cases, subjects are taught for 45 minutes each day.

In 1980, the Government spent about $38 per pupil on primary education. Parents contribute to the cost of their children's education through payments for fees, uniforms, and books.

There is wide variation among schools with respect to fees, enrollments,

and facilities. The ratio of pupils per teacher was 48:1 in 1981. For Standards 1 and 2, the ratio was 65:1. To address the large enrollments, especially at the early grades, the Government is considering the use of teacher aides.

A concern about the quality of education in Lesotho is widely shared. The Education Sector Survey Task Force undertook an analysis of education in Lesotho. Its report, published in 1982, noted a "universal dismay and complaint at what was said to be the declining quality of education." (1) The report goes on to say:

> Particularly distressing were the standards in English and mathematics, the two subjects on which selection for further education hinges. One secondary headmistress said that it would be better if the students learned no English whatever in primary school. They had been so badly taught that much of the time in Form A was spent on reteaching them the foundations of the language. As for mathematics....the average performance on the JC (Junior Certificate Examination) would have merited a failure or bare pass in the past. (2)

Further on, with respect to mathematics instruction, the report notes:

> ....there was suspicion that modern maths 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. (3)

The context of primary education in Lesotho, therefore, was one favorable for experimentation with new technology for learning basic skills.

Collaborative Agreements

As part of the arrangements among the collaborating parties, the Project provided two senior researchers and a graduate assistant. The LDTC provided working space and a staff member to work as a research assistant. NCDC

curriculum officers advised at all stages of the field test.

The project team arrived three weeks prior to the expected start of the field test. At this time, discussions began on the question of schools and grade levels appropriate for the experiment. The Project team had orginally felt that all schools should be from the rural areas in order to control for variance among schools from the beginning. The feeling of the curriclum officers was that, since this was a pilot project, it would be more useful to select a sample of schools reflecting a greater diversity of conditions. This feeling was accepted as the basis on which the sample would be drawn.

The decision as to which grade level was most appropriate for the aids was also made in Lesotho in the weeks prior to the field test. The Project team proposed Standard 3. A consensus of Ministry officials, curriculum officers, and teachers felt that this grade level was too low. They felt that, in view of pupils' difficulties with English and mathematics and for psychological reasons within the schools, it would be wiser to introduce the aids at Standard 6. This was the course followed.

The consultations during the three-week pretrial period were necessarily brief, because the school calendar in Lesotho meant that longer discussions would cut into the time available for the field test. The efforts of LDTC and NCDC were crucial for a successful completion of the field test.

Participating Schools and Children

Five schools took part in the test of electronic aids in Lesotho.

The selection of schools was made from the Ministry of Education's set of computerized school profile data available at the NCDC. Following the recommendation of the NCDC, the project team looked through the NCDC list of cooperating or "experimental" schools for possibilities that would reflect a diversity of conditions found in Lesotho. It was agreed that the sample should include two schools from Maseru, two from the rural areas, and one in a small town. Possibilities were checked against the school profile data to assure accessibility of schools and no unusual conditions with respect to teachers, enrollments, or classroom assignments. Four NCDC experimental schools and one non-experimental school were included in the list of possibilities.

Nomination of five schools was made in consultation with NCDC officers. The selection was approved by the Ministry of Education. Visits were then made to the schools to explain the project and demonstrate the aids. All five schools nominated accepted the invitation to participate.

As was hoped, the participating schools did reflect a diversity of conditions found in Lesotho's primary schools. There were two schools located in Maseru. One school, Iketsetseng, operates privately, has excellent facilities, and enjoys a reputation as being one of the finest schools in the country. The other Maseru school, Hoohlo Primary, operated by the Anglican church, could be considered a more typical urban primary school. It also enjoys a good reputation and has average facilities that are rather crowded. The third school, Morija Primary, is set in a small town south of Maseru. The school is operated by the Lesotho Evangelical Church, has average facilities, and is somewhat crowded. The two rural schools, Masapong and O.B. Collins are situated off main roads about forty five

minutes from Maseru. Masapong is also operated by the Anglican Church and has average facilities, inadequate furniture, and small classes. O.B. Collins is operated by the African Methodist Church; it has average facilities and small classes. Details about the schools are contained in Appendix B-1.

The limits of time and resources, together with the fact that the study was the first of its kind, meant that practical considerations weighed heavily in the selection of the sample. The sample was not presumed to be representative of the most abject conditions that sometimes face primary education in developing countries. No schools in the sample were completely lacking in classrooms, were extremely overcrowded, poorly managed, or taught by teachers regularly absent from or indifferent to their tasks.

Enrollments in the participating classes ranged from 29 to 62 pupils. The language control group was made up of 134 pupils in three different streams of Standard 4 at Iketsetseng Primary School. Only one of the experimental groups, the class at Hoohlo that used the language aid for twelve weeks, shared a classroom with another group of pupils.

The participating teachers also reflected a diversity of backgrounds, professional preparation, and teaching styles. Despite the differences among the teachers, all of them proved themselves to be capable educators and conscientious about their tasks. Details about the backgrounds of teachers can be found in Appendix B-1.

For the purpose of avoiding delays in starting the field test, the two Maseru schools were designated as the ones that would use the aids for twelve weeks. For reasons mentioned above, the aids were to be introduced at the Standard 6 level for both language and arithmetic. Plans called for the class using the language aid to serve as the control class for the arithmetic

treatment and vice versa. This did not work out as planned, since early results showed it was necessary to shift the testing of Speak and Read to Standard 4. The Standard 4 class at Iketsetseng then became the language control group. Midway in the experiment, the Standard 3 class at O.B. Collins was added as a four-week language group.

Some 509 pupils took part in the experiment either by using the aids or by serving as control subjects. Testing was discontinued for a large number of these pupils when it was decided to move the language aids to Standard 4. The children in Standard 6 were in the age range of 11-13, Standard 4 in the range of 9-11, and Standard 3 in the range of 8-10.

The need to avoid delays in starting the study meant that little time was available for familiarizing teachers in the two Maseru schools with use of the aids and discussing with them how best to introduce the aids to their classes. The teachers in these schools were quick to understan how to use the aids and adapted well to the new and unfamiliar task of using the aids in their classes. The project team assisted in explaining the aids to the pupils on the first day aids were used in these classes.

More time was available for the task of familiarizing teachers from the other schools with using the aids. An aid was left with these teachers for practice on prior to classroom introduction. The week before their classes received the aids, teachers were brought in to observe the Maseru classes using the aids. At the O.B. Collins school the aids were introduced by the teachers without any assistance from the project team.

The Instructional Supplement

The objective of the field test was to examine the effects of electronic learning aids when used as a supplement to regular school instruction. This supplement consisted of drill and practice in basic skills essential for proficiency in English or arithmetic. The aids were not intended to replace parts of the curriculum or the teacher. The instructional supplement was left purposely open-ended in order to generate the kind of data needed for a more refined definition of an instructional treatment for empirical testing at some future date.

Teachers were asked to use the aids, as circumstances permitted, for one hour per day during the appropriate time for English or arithmetic. Pupils were asked to use the aids in groups of four. Groups were expected to operate cooperatively with pupils helping one another and each member having opportuniites to manipulate the aids.

The overall length of the instructional supplement varied. Two classes used the aids for twelve weeks, two for eight weeks, and two for four weeks. The reasons for introducing the aids at differenct times are explained in Chapter V.

Not surprisingly, actual classroom use of the aids did not approximate the one hour a day standard that was planned. There were the usual interruptions in the calendar because of examinations, vacations, and special events. A discussion of the actual time-on-task outcomes is contained in Chapter III.

Apart from prescribing the time to be devoted to using the aids, there were few guidelines given to teachers on how to or, in some cases, let their

pupils decide what routines to use and what levels of difficulty to follow. Similarly, the role to be played by teachers while the aids were being used and the way members of learning groups interacted were allowed to vary.

References

1. The Education Sector Survey: Report of the Task Force. Maseru, Lesotho, 1982, p. 12.

2. Ibid., p. 12

3. Ibid., p. 13

Chapter III

TECHNICAL FEASIBILITY

The feasibility of an innovation rests in no small way on how well it works in a purely technical sense. The innovation must perform as expected with consistency, reliability, durability, cost-effectiveness, and safety. Failure to meet such minimal standards of operation in the particular context in which an innovation is to be used would condemn it for consideration before its effectiveness could even be established.

In the case of using electronic learning aids in a developing country, technical feasibility could not be assumed on the basis of their performance in North America. The aids would have to withstand the special rigors of dust, rough handling, unsafe storage, remoteness from repair services and sources of batteries if they were to succeed in developing countries like Lesotho. At the very least, it seemed imperative that electronic learning aids prove their technical feasibility according to the following criteria:

1. that the individuals for whom their use is intended get sufficient exposure to the aids
2. that batteries last long enough to avoid undue problems of resupply
3. that the aids be durable under normal conditions of use in Lesotho's primary schools
4. that the aids be kept safely in the schools without loss or theft
5. that pupils can understand the synthetic voice and read the visual display screen in the aids.

To determine how well the aids met these criteria, data was gathered from different sources. Computerized class rosters were distributed weekly to teachers of test classes to record 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 they as teachers did while the aids were in use, and what special problems or challenges learning aids posed to them. Finally, general observation and informal conversation with teachers and school managers provided details that served as a context for interpreting the other data.

The amount of time the learning aids were used had an important bearing on how effective they would prove to be. If the pupils were not given sufficient exposure to the aids, it would not be known whether the lack of a significant effect on learning should be attributed to the failure of the learning aid or the non-existence of a treatment effect. Moreover, the willingness of teachers to comply with the prescribed level of use would be indicative of at least minimal interest in, and support for, their use in primary classrooms.

The prescribed minimum amount of time for the aids to be used was an hour and a half to two hours a week. This was considered sufficient exposure to produce a noticeable effect on learning. Thus, teachers were encouraged to schedule the aids into their daily routine at their convenience as long as they could roughly adhere to the minimum weekly exposure.

Records kept by teachers indicated that the level of use met and sometimes far exceeded the recommended amount. All teachers faithfully adhered to the weekly regimen as can be seen in Table 3.1. The average amount of exposure differed substantially from class to class, but in no case did it fall significantly below the 90 minute minimum for the week.

TABLE 3.1

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)*	36hrs. 35 min.	3hrs.
Iketsetseng VI	14hrs. 35 min.	1hr. 20min.
Masapong IV (VI)*	12hrs. 35 min.	1hr. 30min.
Morija VI	15hrs. 40 min.	2hrs.
OB Collins III + IV	12hrs. 25 min.	2hrs.30min.

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

Scheduling constraints forced a few teachers to use the aids for a longer session on only two days a week. Others preferred to use the aids every day for shorter periods. It should be noted that the cooperation of the teachers in this regard was all the more impressive given that the time of the study coincided with the end-of-year preparation for exams.

There is no way to know the extent to which teachers complied with the prescribed minimum of use because of the regular monitoring visits and the importance attached to the research. Perhaps a different pattern of use would prevail under conditions less favorable than a pilot study. Moreover, the level of use prescribed for this study may not be sufficient to obtain effects that appear only with more intensive or long term exposure. But it can be concluded that the amount of time learning aids were used clearly fulfilled the requirements of this study.

The rate at which batteries were consumed represented another important question of technical feasibility. If learning aids can be expected to be used with manageable recurrent costs, battery life must be long enough to avoid the inconvenience and expense of too-frequent replacement. In a country where schools are often located in remote mountainous areas far from commercial sources of batteries, such a concern is crucial.

Literature from the manufacturer states that batteries normally give fifteen hours of use in the Speak and Math and Speak and Read before needing replacement. It was considered important to put this estimate of battery life to an empirical test under conditions in Lesotho.

Teachers were asked to and, in fact, did faithfully keep a record of the times when they changed batteries. Adding these battery changes to the number of original batteries in the aids yields figures on total battery consumption for each school during the test period. These figures are contained in Table 3.2.

Obtaining an accurate assessment of actual battery life is more difficult than it appears. The accuracy of the figures in Table 3.2 is questionable because use of the aids was not limited to the experimental classes alone. Other classes in participating schools sometimes used the aids as well. There was no record of the total time that other classes used the aids. Therefore, calculations of the number of batteries per week or per pupil will not be entirely accurate. What the totals do show is the number of batteries needed for regular use in one class and less regular use in a second.

TABLE 3.2

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
Total	59	336	—	16.9

* 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.

As Table 3.2 shows, battery life varied from school to school. The average number of hours per battery for all the schools was 16.9 hours. This is above the 15 hour estimate of the manufacturer. Whether this level of battery life gives rise to recurrent costs that are considered feasible is something that will vary from place to place.

Batteries used in this experiment were high quality alkaline batteries purchased both in the U.S. and Lesotho. These were the type recommended by the manufacturer for use in the learning aid. While generally available in Maseru and larger towns, alkaline batteries are reportedly not so readily found in smaller towns where, instead, cheaper carbon batteries are more common. What effect the use of carbon batteries in devices like the

Speak and Read and the Speak and Math is not known.

The durability of the aids was another part of the question of feasibility of the aids. Since most developing countries cannot afford an innovation that requires regular maintenance or replacement, the durability of the learning aid under potentially harsh conditions of use was important. In this case, the evidence from Lesotho is unequivocably positive.

Out of the 62 learning aids actually put into service, only three malfunctioned and had to be replaced. This was even after a few had been dropped. By contrast, the accompanying picture books were badly frayed in some test classes by the end of the experiment. This low incidence of malfunction and breakage would probable not be replicated in a longer experiment. Without a basis for making specific comparisons, the durability of the Speak and Math and the Speak and Read cannot be compared to that of other educational technology. But their durability in this instance clearly seems remarkable.

Likewise, safe-keeping of the aids proved to be less a problem than anticipated at the outset. Teachers were asked to find secure storage facilities for the aids as part of their responsibilities in the project. Teachers took this seriously and, as a result, none of the aids were lost or stolen during the experiment. As was the case for the other questions of technical feasibility, it cannot be certain whether the consistent safe-keeping of the aids was the result of the regular monitoring visits or the unwavering honesty and vigilance of the teachers and administrators.

The feasibility of using electronic aids in school settings in a developing country depends on whether pupils can hear, see, and understand the instruction presented by the aids. This was especially critical with a device that contains a very mechanical sounding synthesized voice, uses North American English words, and makes use of a visual display with unfamiliar shapes.

How well the learning aids were understood must be assessed somewhat more subjectively than the other aspects of technical feasibility. No tests were conducted to measure the extent to which pupils found difficulty with the voice, volume level or visual display of the aids. To some extent, these questions are answered implicitly by the results of learning effects testing. But direct evidence consists only of inferences made from observations of pupils and from statements made by teachers and pupils.

According to this data, most pupils adapted relatively quickly to the voice and visual display. Many pupils, of course, were bewildered at their first encounter by the voice in the learning aids. But with continued experience with the aids, pupils were able to comprehend the routines well enough to answer questions and solve problems correctly.

Adaptive behavior was often observed in pupils' use of the learning aid. Pupils held the aid close to their ears to overcome the distraction of background noise. They sometimes used the screen to cross-check what the voice said. Pupils also made frequent use of the "REPEAT" function on the aids and relied on others in their learning groups to help them when they could not understand.

Several teachers reported that some pupils still found the learning aid difficult to understand even after several weeks of exposure.

However, it was difficult to verify through observation whether difficulties in understanding the aids had to do with the voice or something else.

Many pupils recommended the voice in the aids be made louder. However, raising the volume level of the aids would require a trade-off with the need for a moderate level of background noise. The higher the background noise, the more it cancels out the benefits of the louder volume and distracts other classes that may be held in the same room. So any consideration that might be given to raising the volume level would have to be weighed against its undesirable consequences on the other elements of the learning environment. One recommended improvement that had almost unanimous appeal among pupils and teachers alike was for a more intelligible and human sounding voice.

In summary, the results seemed to point clearly to the conclusion that electronic learning aids met the conditions of technical feasibility. They were made available to pupils conscientiously by their teachers. The batteries in the aids lasted at least as long as their manufacturer's claim. The aids proved to be durable and were kept safely by the schools. Finally, the technical characteristics of the aids were sufficiently intelligible for most pupils to use them without difficulty.

Chapter IV

HUMAN USE EFFECTS

The success or failure of an instructional technology does not rest on its technical feasibility alone. How it affects potential users is equally important in assessing its value. This was considered particularly important in the case of electronic learning aids. Little prior information was available to predict the effects of using learning aids in formal educational settings. These effects were thought to be even less predictable in developing countries, where computer technology in education is only now beginning to appear.

Questions raised at the outset of the study anticipated some possible consequences that could impede the successful introduction and use of learning aids in a developing country:

- -- Would features of electronic learning aids be seen by teachers and pupils as inappropriate for the local culture?
- -- Would the aids be regarded as toys rather than genuine learning tools, perhaps giving rise to undesirable behavior?
- -- Might the attitudes of teachers or pupils, the size of classes, the physical arrangement of classes, or some other factor render group use of learning aids impractical, thereby making their introduction considerably less cost-effective?
- -- Would the instruction they offer be seen as either inconsequential or irrelevant?
- -- Would pupils lose interest in using the aids over time?
- -- Would learning aids require a drastic and perhaps unacceptable alteration of pupil/teacher relationships?
- -- In supplementing instruction in a radically different way, would the aids detract some from the traditional teaching of other subjects?

-- Would the logistics of passing out and collecting aids and safely storing them be so time-consuming or inconvenient as to discourage their use?

These questions became the basis for investigating the feasibility of electronic learning aids from the standpoint of their human users. The scope of the present study required that this effort be focused on two aspects:

1. The teaching/learning dynamics of using aids in the classroom -- that is, in a general sense, what happens when aids are used in classrooms in Lesotho and, more specifically, how do pupils behave as they work with them.

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

Learning/Teaching Dynamics with the Learning Aids

One of the major unknowns at the outset of the study was how an innovation like electronic learning aids would affect the classroom environment of the primary school. A device that engages the senses of sight, hearing, and touch all at once could not help but evoke some new behavior from pupils for whom education usually means listening to a teacher talk. This behavior could range all the way from serious engagement in learning to frivolous amusement as an entertaining activity. Teachers might react to the prospect of a change in their pupils' behavior with either strict control to minimize anticipated negative effects or with interventions to exploit potential benefits of the learning aids.

The plan to use learning aids in small groups was a source of potential difficulty. Group-organized learning is not widely practiced in Lesotho's

primary schools because most Basotho teachers prefer to deliver their lessons in the class as a whole rather than to create opportunities for peer learning. Moreover, overcrowded classrooms often make group work difficult to arrange physically. Under these conditions, learning aids might cause discipline problems or result in other behavior not conducive to efficient learning. There was concern too about whether pupils would be willing to share the aids equally among all members of their groups.

Several kinds of data were collected in order to answer such questions about learning/teaching dynamics. General and spot observations were done early in the study to gain a general sense of how the user groups behaved with the aids. A spot observation consisted of a randomly chosen two-minute period in which as many as possible of the behaviors and statements during that time were recorded. A structured observation instrument was then designed based on insights drawn from these initial observations. This was put into service later in the study to obtain more precise data about the frequencies of observed behaviors. Throughout the course of the study informal conversations with the teachers helped to clarify and confirm the information from the other sources.

The methods used were not always effective under the circumstances of the study. Both spot and general observation suffered from the once-a-week school visits. Only toward the end of the experiment did the novelty of the researchers' presence begin to wear off and unobtrusive observation become possible.

General Characteristics of Group Learning with Learning Aids

The learning aids were introduced in test classes on the day that learning groups of four pupils were formed. Groups were formed among friends

or among pupils seated close to one another. These groups quickly took on an identity and permanence of their own. Although teachers sometimes intervened to insure that groups included both more able and less able pupils, the composition of the groups did not usually change during the experiment. The teachers appointed a leader in each group to take charge of dispensing and collecting the aids.

Teachers asked pupils to take turns manipulating the keyboard. Sharing was made easier by a built-in cycle in the aid which computes and announces a score for the user after every five questions. Pupils usually passed the aid on to others at the end of these cycles.

At first, teachers prescribed the manner of using the aids. Pupils were told the sequence of buttons to push and the functions and levels of difficulty to follow. Some teachers maintained strict control over pupil use through much of the experiment, while others began to shift toward a less directive approach after the first few sessions. No attempt was made to impose any style of supervision other than that with which teachers felt comfortable. Even though teacher specification of the function and difficulty level to be used did continue in all test classes to some extent, independent group work generally became the rule after pupils had mastered the keyboard.

Groups adapted to the learning aids differently. Competition among members appeared to be a major motivating force in many groups. Scores were kept of each pupil's performance in these groups and often reported to the teacher at the end of the session. The prospect of having one's score recorded by the teacher seemed to give the exercise a legitimacy it might not otherwise have had.

A few groups functioned in more cooperative ways. Members of these

groups worked out solutions to the problems together before one pupil pressed the buttons on the aid. Like the other groups, each member would take a turn manipulating the aid. Some of these groups kept a group score as if playing against the machine.

Pupil preference for competing with each other was unexpected. At the outset of the study, it was thought that pupils would answer questions or solve problems cooperatively. One explanation might be that the score-keeping feature of the learning aid encouraged competition among individuals. Perhaps, too, competition is no less powerful as a motivator among Basotho children than among North American children.

In order to learn how pupils related to the learning aid, spot observations of several learning groups were conducted in two classes. Unfortunately, this did not reveal as much information about the interaction of pupils with the learning aids and each other as was hoped because of the obtrusiveness of the observers and the difficulty of sampling all conceivable behavior. However, summaries of three two-minute spot observations are presented to give some flavor of the groups' interactions with the aids.

Spot Observation -- Standard 6 Math

> The learning group was composed of four boys. The Speak and Math was being used by one student with the others watching. He said the answer aloud and pressed the buttons. The answer was correct so he went on to the next problem. After he correctly answered five problems, he passed the aid on to another pupil. The others did not talk much while one was solving the problem except to urge him to work fast. However, sometimes the others would say the answer aloud as a way of hurrying him along.

Spot Observation -- Standard 6 Math

Pupils teased each pupil manipulating the Speak and Math to encourage him or her to work fast and give a correct answer. This was said in Sesotho and was not done in a harsh manner. Pupils would say things like, "If you can miss this one, you should forget about school. You're useless." This was said laughingly, however.

Spot Observation -- Standard 6 Language

The group was composed of three boys; one of the boys was slow and the other quick in responding to the learning aid. The faster pupil asked in Sesotho if he could answer the question for him or if the pupil wanted to try it himself. The user said, "Yah, let's go man." The quicker pupil, turning the aid toward himself, said, "Listen, didn't you hear that?" They started berating each other about how many correct each would get. -The third pupil said, "You are wasting time."

As the aid was passed, one pupil asked another what the aid said and the other told him. The first asked him if he were sure. The first pupil went on to say, "Let's hope you heard that clearly, Abuti (meaning Brother.)" The buttons were pressed. "You see," said the second pupil. "Do it yourself. Hey man, press that."

These examples suggest the seriousness with which pupils regarded the learning aids. No indication is given that the aid was treated as a toy. There is some hint of the differing abilities pupils brought to the task and of a kind of pecking order that emerged based on quickness of response to the learning aid. Finally, these examples show that pupils were willing to share the learning aids and that three or four pupils sitting together with an aid could indeed function as a learning group.

Significant Pupil Behaviors

The unstructured observation conducted during the first half of the

experiment suggested a range of pupil behavior in connection with using electronic aids. But it said little about the respective strengths of those behaviors. The frequency with which some behaviors occurred was important for answering two fundamental questions about group use of electronic aids in schools in a country like Lesotho:

1. Are pupils engaged in the learning task?
2. Do pupils have equal opportunities to operate the aids in the learning groups?

The answers to these questions are neither self-evident nor trivial. There was no reason to assume that pupils would remain continuously attentive to an electronic aid any more than they would to another instructional material. Despite their teacher's instructions to do so, pupils could not necessarily be expected to take turns using a device so obviously fun to operate. If it were found that pupils were not engaged with the aids, it would be hard to conclude that electronic aids were being regarded as a serious learning tool or that group use in schools was educationally productive. If it were found that pupils did not take turns operating the aids, it might suggest that some pupils were not benefiting from the aids, or, again, group use was not practical.

Four categories of behavior that addressed these two questions became the basis of the observation instrument: engaged, not-engaged, disruptive, and transition. These four categories were broken down into specific behaviors to be observed. They are listed on a coding form (see Figure 4.1) and defined in Appendix D-1.*

*Assistance 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.

FIGURE 4.1

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

TONE	BEHAVIORS: ENGAGED		NOT ENGAGED			DISRUPTIVE		TRANSITION			TOTAL
	Manipulating	Attending	Non-Attending	Doing other	Out of Lesson	Interferes Aid	Interferes Other	Passing	Teacher	Waiting	
LOW											
HIGH											
SUB-TOTAL											
TOTAL											

Engaged and not-engaged behaviors, of course, indicated pupil attention or non-attention to the learning aids. The disruptive category separated out non-attending behavior that interfered with others in the group, and the transitional category covered legitimate interruptions of activity. The emotional tone of the group was noted to provide a simple, but usefu, framework within which to interpret the above behavior. In addition, data about the general context of the classroom (whether noisy or not), the ambiance of the larger setting where the classroom was located (whether noisy or not), and the lesson type (whether the machine functions being used require immediate or delayed responses) were recorded.

Behavior and emotional tone were sampled every minute for ten minutes, recorded and later tabulated on the coding sheet. One minute observation intervals seemed to be a reasonable compromise between the need for sensitivity to behavioral fluctuations and a manageable pace of recording behavior. A ten minute observation period seemed sufficiently long to obtain a representative sample of individual behavior in the learning groups.

Two pupils, who were of the opposite sex and seated close to one another, were randomly chosen in five of the experimental classes. They were observed for four weeks. While admittedly tapping a small sample of total behavior, observing the same two individuals did permit more intensive study of the subjects. It also made it possible to notice changes in behavior over time.

Observations were conducted during the regular sessions when learning aids were used in the classes. Ten minutes were allowed for groups to set up and begin functioning normally. Then, one subject was observed on the minute, and the other on the half minute for ten minutes.

Results of the observations reflect a preponderance of engaged behavior (79%) in all groups. Table 4.1 shows a breakdown by category for each of the ten observed individuals.

TABLE 4.1

TOTAL BEHAVIOR BY SUBJECT

STUDENT	BEHAVIOR TALLIES				TOTAL
	ENGAGED	NOT ENGAGED	DISRUP-TIVE	TRANSITION	
SCHOOL: IKETSETSENG					
STUDENT (M)	39	0	1	0	40
STUDENT (F)	37	2	0	1	40
SCHOOL: HOOHLO					
STUDENT (M)	13	27	0	0	40
STUDENT (F)	26	13	0	1	40
SCHOOL: MASAPONG					
STUDENT (M)	35	5	0	0	40
STUDENT (F)	39	1	0	0	40
SCHOOL: MORIJA					
STUDENT (M)	23	15	1	1	40
STUDENT (F)	40	0	0	0	40
SCHOOL: O.B.COLLINS					
STUDENT (M)	34	5	0	1	40
STUDENT (F)	30	5	1	4	40
TOTAL	316 (79%)	73 (18.3%)	3 (.7%)	8 (2%)	400

Non-engaged behavior was observed only 18.3% of the time. Less than 3% fell into either the disruptive or transitional categories. If transitional tallies are included under engaged and disruptive tallies under non-engaged, an even greater preponderance (81%) of tallies fell under engaged behavior. Clearly, this sample of pupils was absorbed in the tasks presented by the learning aids a significant amount of the time.

The aggregate figures (with disruptive and transitional behaviors collapsed into non-engaged and engaged respectively) broken down by sex are displayed in Table 4.2. The high percentage of engaged behavior (89%) among females suggest that the aids fostered even more attentive behavior among girls than boys.

TABLE 4.2

ENGAGED/NON-ENGAGED BEHAVIOR BY SEX

SEX	BEHAVIORS		TOTAL
	ENGAGED	NOT ENGAGED	
MALES	146 (73%)	54 (27%)	200
FEMALES	178 (89%)	22 (11%)	200
TOTAL	324 (81%)	76 (19%)	400

The emotional tone of the observed sessions was so uniformly low that it was felt unnecessary to display the tabulations here. Similarly,the noise level both in the rooms and outside the classrooms was generally not high enough to affect normal use of the aids. In terms of lesson type, most groups were operating their learning aids at difficulty levels where a normal response rate was possible. Toward the end of the experiment, some of the observations of Speak and Math use did include more paper and pencil calculations required for more difficult problems.

Table 4.3 breaks down engaged and non-engaged behavior by school.

TABLE 4.3

SCHOOLS	BEHAVIORS		TOTAL
	ENGAGED	NOT ENGAGED	
Iketseteng	77 (96.3%)	3 (3.7%)	80
Hoohlo	40 (50%)	40 (50%)	80
Masapong	74 (92.5%)	6 (7.5%)	80
Morija	64 (80%)	16 (20%)	80
O. R. Collins	69 (86.3%)	11 (13.7%)	80

It is difficult to explain the variation in engaged behavior between schools. The lower percentage (50%) of Hoohlo, the Standard 4 class that used the Language aid for 12 weeks, can be explained in part by the low engaged behavior of one of the two observed pupils. The behavior of this pupil was atypical of the other nine within the sample and possibly resulted from his awareness of being observed.

Table 4.4 relates engaged/non-engaged behavior to length of treatment. The lower percentages of engaged behaviors in the 12 week treatment group compared to the 4 week treatment group suggests a slight reduction, but still substantial maintenance of attending behavior over time. Some decrease in attending behavior would be expected as the initial novelty of the aids is replaced by routine use.

TABLE 4.4

BEHAVIOR BY LENGTH OF TREATMENT

LENGTH OF TREATMENT	BEHAVIORS		TOTAL
	ENGAGED	NOT ENGAGED	
12 Weeks Iketsetseng & Hoohlo	117 (73%)	43 (27%)	160
8 Weeks Mas & Mor	138 (86.3%)	22 (13.7%)	160
4 Weeks OBC	69 (86.3%)	11 (13.8%)	80

It is possible that this reduced engagement in the task reflected waning interest when pupils were waiting their turns to manipulate the learning aid.

When broken down according to lesson type, the data suggest that the math aid elicited somewhat more engaged behavior. (See Table 4.5).

Table 4.5

BEHAVIOR BY LESSON TYPE

LESSON TYPE	BEHAVIORS		TOTAL
	ENGAGED	NOT ENGAGED	
Math- Iketsetseng Morija	141 (88%)	19 (12%)	160
Language- Hoolo, Masapong & O.B. Collins	183 (76.3)	57 (23.7)	240

It is possible that the structure of the Math learning aid, with its potential to present 100,000 problems, might sustain motivation longer than the SR, which draws only from a pool of 230 words. The words tend to repeat more often than do specific problems on the SM. While this repetition may be appropriate for a young child, it may discourage attending behavior in an older child who is ready to move on to new material more quickly. Separation of these same results by sex (Table 4.6) suggests little difference between boys and girls.

Table 4.6
BEHAVIOR BY LESSON TYPE AND SEX

LESSON TYPE	ENGAGED		NOT ENGAGED	
	MALES	FEMALES	MALES	FEMALES
MATH	63(39.3%)	78(48.8%)	17(10.6%)	2(1.3%)
LANGUAGE	83(34.6)	100(41.7)	37(15.4)	20(8.3)

The second major question that the observation of pupils hoped to answer was: while working in groups, do pupils get an equitable share of the opportunities to actually operate the aid? On the average, subjects were observed manipulating the aid one out of every five times (20% of the time). If only engaged behaviors are considered (Table 4.7), pupils on the average got the chance to actually push the buttons of the learning aid a fourth of the time--about what would be expected if the aids were being shared equally among a group of four active learners.

Table 4.7

MANIPULATING / ATTENDING BY LENGTH OF TREATMENT

LENGTH OF TREATMENT	ENGAGED BEHAVIORS	
	MANIPULATING	ATTENDING
12 weeks (IKET & HOOH)	23%	77%
8 weeks (MAS & MOR)	26%	74%
4 weeks (OBC)	30%	70%
TOTAL	25%	75%

Observed incidents of manipulation did, however, appear to drop off slightly as length of treatment increased. The tendancy for pupils to tackle problems at higher difficulty levels in the aids---some of which required paper and pencil solutions---probably account for the fewer observed incidents of manipulating the keyboard.

Closer scrutiny of the data reveals considerable variation in manipulating behavior among subjects. Table 4.8 separates manipulating and attending behavior as percentages of all behaviors for each subject. For example, the female pupil in Iketsetseng manipulated the aid only 7.5% of the time; but when others were manipulating, she was paying attention 85% of the time. By contrast, the boy from Hoohlo manipulated the aid 15% of the time, but

attended only 17.5% of the time. He was thus engaged in the task only a third of the time, compared to more than nine-tenths of the time for the girl from Iketsetseng.

Table 4.8
MANIPULATING / ATTENDING BEHAVIOR BY SUBJECTS

STUDENT		ALL BEHAVIOR		
		MANIPULATING	ATTENDING	ALL OTHER
IKETSETSENG	STUDENT(M)	15%	82.5%	2.5%
	STUDENT(F)	7.5%	85%	7.5%
HOOHLO	STUDENT(M)	15%	17.5%	67.5%
	STUDENT(F)	27.5%	37.5%	35%
MASAPONG	STUDENT(M)	20%	67.5%	12.5%
	STUDENT(F)	20%	77.5%	2.5%
MORIJA	STUDENT(M)	12.5%	45%	42.5%
	STUDENT(F)	35%	65%	0%
O.D. COLLINS	STUDENT(M)	30%	55%	15%
	STUDENT(F)	17.5%	57.5%	25%

How these differences in pupil behavior come into play is illustrated by the two pupils from Morija. The girl was very quick to solve the problems and was actively involved in the task 100% of the time she was observed.

The boy, by contrast, seemed much slower to solve the problems and made frequent mistakes when he did try. He chose to remain on the fringe of the group and allow the others to monopolize the aid.

Pupils participated in group activity with different levels of interest and involvement. Pupils who could answer questions were likely to be the ones to do the pushing of buttons. They were quicker to become impatient and say answers aloud when a slower pupil was unsure of the answer. This often meant that slower pupils had no opportunity to figure out answers for themselves without first hearing from others.

These differences in manipulation behavior raise questions about how evenly the benefits of the learning aids are distributed. Do the conditions under which the learning aids are used favor some pupils over others? If learning effectiveness were assumed to be a function of active involvement, it might be argued that those who are more assertive with the learning aids would be better able to optimize the learning opportunities provided by those aids.

But actual manipulation of the learning aid may not be the key issue. Perhaps the potential to learn in a group does not require equal access to the aid. Pupils might be able to learn effectively simply from being <u>present</u> in the group. The nature of material which must be committed to memory, such as arithmetic operations and vocabulary, plus the knowledge that corrective feedback follows all answers may allow pupils to learn from each other regardless of who happens to respond first or most frequently or who operates the keyboard.

Reactions of Participants Toward Learning Aids

What teachers, pupils and administrators thought about electronic learning aids was the second major aspect of their effect on human users. Perhaps as much as the capacity to enhance learning, the degree to which an innovation is accepted is likely to be crucial to its ultimate effectiveness. Educational literature is replete with examples of innovations that failed for lack of support among those who actually use them.

The question of acceptance of technological innovations is of particular concern in societies which have less experience with Western technology and perhaps less resistance to its novelty. An exaggerated fascination with technical sophistication of a device can easily cloud the real issue of whether it performs a useful function. Such an attitude could lead to a rosy expectation of what the innovation would accomplish. On the other hand, a fear of unfamiliar technology could unfavorably bias the user against the innovation. Both technophobia and its opposite, overacceptance, create barriers to the effective introduction and use of learning aids in these settings. Both were expected among the participants in Lesotho.

The introduction of a radically different technology in the classroom could well require drastic and perhaps unacceptable changes in the relationships between pupils and teachers. For one thing, learning aids were entering the classroom in potential competition with the teacher. Given the acculturation of pupils to their teacher's traditional role of authority, it was not certain that pupils would accept learning aids as an alternate source of knowledge. Likewise, there was doubt that teachers would feel sufficiently comfortable with the aids to accept the somewhat unfamiliar role of facilitator, rather than dispenser of knowledge.

The overall purpose of this investigation was to determine what teachers, pupils and administrators felt about various aspects of the aids and the experiment in which they were being tested. Experience during the first several weeks of the experiment suggested specific items that became part of the actual interview schedules. The three instruments are shown in Appendices D-2 through D-4.*

Most of the interview items called for yes/no responses. While yes/no questions run the risk of reducing opinion to categorical answers, the items seemed sufficiently probing to tap the more subtle aspects of opinion. Respondents were also encouraged to use these yes/no questions as starting points for elaborating their answers. Wherever applicable, results of these interviews were tabulated, as shown in the Appendices. Because patterns were inferred from the aggregate meaning of the data, it was not considered necessary to discuss at length responses to each specific item. The composite picture produced by these results and by much informal conversation gives a good indication of how the participants reacted to the use of learning aids in primary school classrooms.

Obtaining data through interviews faces an inherent challenge. One of the problems was eliciting the true responses of the respondent. Subjects' statements frequently seemed to reflect what they thought the interviewer wanted to hear, rather than what they actually believed. Efforts, therefore, had to be make to corroborate answers by restating questions in different ways or by trying to disabuse teachers of the idea that only positive opinions were being solicited.

*_____ The interviews were prepared, conducted, and tabulated for the Project by M.S. Vijay Kumar.

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.

What teachers ultimately thought about electronic learning aids must be seen in relation to their attitudes at the start of the experiment. 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.

Beneath this fascination was an apprehension and skepticism of how this strange and new device might affect them as teachers. Many doubted their 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 aid and its relevance to their syllabi. But, all 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. Given these constraints, it seemed unlikely that teachers would have any incentive for embracing an innovation that might take more of their time or complicate their job in unexpected ways.

Early reticence among teachers gave way to gradual acceptance of, if not enthusiasm for, learning aids. Many of the early fears teachers harbored were allayed through continued experience with the aids. Their apprehension was 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 diminishment of or threat to their authority from the presence of learning aids in their classrooms. Their conventional teaching of other subjects also did 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. With this realization, teachers reflected a new appreciation that an activity which was instructional could also be fun.

Greater acceptance was accompanied by recognition of the potential benefits of learning aids in the classrooms. All teachers acknowledged the capacity of the aids to serve the special needs of different pupils. For example, more individual attention could be given to less able students while more able ones worked with the aids. Drill and practice of arithmetic and vocabulary were singled out as particularly useful features of the aids due to the difficulty of making sufficient time available in the classroom for these activities. Competition and cooperation observed in pupils were seen as having positive implications for student performance in general.

The benefits of learning aids sometimes manifested themselves in more personal ways. One teacher found unexpected rewards in the welcome relief the learning aids provided from the stresses of conventional teaching. She reported that she had less severe sore throats as a result of breaking the routine of standing and continually talking to a class of 70 pupils.

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. Teacher behavior, in fact, provided an important check on the veracity of verbal statements.

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.

The questions remain, of course, as to what extent teacher acceptance and regular use of the learning aids in their classrooms was a consequence of significance attached to participating in research or of genuine enthusiasm for the innovation. Would teachers be as positively disposed toward the aids without the special conditions created by weekly visits from

expatriate researchers or Ministry officials? Given the importance of covering a syllabus, would they bother to use the aids regularly when no records of their use were being kept? Indeed, would the aids remain physically present under non-experimental conditions? These are some of the questions that must be answered before the long-term acceptance of this technology can be assured.

Administrator Reactions

The sample of seven educational administrators interviewed was intended to provide a diversity of opinions among those likely to have decision-making power over how or if learning aids are used. Among these were: representatives of English and Math curriculum divisions of the National Curriculum Development Centre (NCDC): the Chief Education Officer and the Technical Adviser for Planning of the Ministry of Education; the Deputy Director of NCDC: and the Director of LDTC. Like the interviews with teachers, these interviews were expected to reveal reactions among administrators to two issues:

1) the aids and their usefulness in Lesotho, and

2) the factors that should be addressed by decision-makers in Lesotho or other countries to make decisions if more extensive and effective use of the aids is being considered.

In contrast to teachers, administrators tended to judge electronic learning aids in the context of the larger effort to reform education in Lesotho. Their concerns could be summed up in one question: Would the learning aids perform a useful educational function at a cost competitive with those of training teachers, hiring teacher aides, or providing a competing educational technology? In their opinion, the aids would have to

overcome skepticism generated by the unfulfilled expectations associated with attempts to introduce educational technologies in the past. Suitability to local conditions was considered an important prerequisite for learning aids to succeed in Lesotho.

Observation of the learning aids being used in primary classrooms helped convince several administrators of the need to consider their potential value. An important part of the aids' appeal was their capacity to create enjoyable opportunities for drill and practice in basic skills. Insufficient drill and practice has been implicated in the worsening test scores of primary school leavers. Such insufficiency is due, in part, to a lack of teachers or teachers' aides, teacher absenteeism, multiple class responsibilities, and high pupil-to-teacher ratios. To the extent that learning aids could help offset the effects of these problems, administrators were prepared to consider seriously their potential contribution to primary education.

In acknowledging the possible role of electronic learning aids in addressing such problems, administrators also stressed the importance of establishing their suitability to the learning environment and identifying the support system needed to insure their successful use. References were made to the unrealized potential of promising educational technology such as radios and tape recorders due to the failure to train teachers to fully exploit their benefits. One administrator cited the failure of another experimental innovation involving the use of folded cards on a clothes line for outdoor literacy classes because its designers had not anticipated the effects of Lesotho's strong winds.

All administrators rated the initial procurement cost and recurrent maintenance expenses of learning aids as a difficult obstacle to any large

scale introduction in Lesotho. Equity considerations dictated that aids be supplied to all schools in the country, which would exacerbate the financial burden. There was a difference of opinion on whether the aids' high cost would preclude their deployment. Three administrators found such costs indefensible when many schools already lacked even the most basic equipment and instructional materials. Most administrators, however, preferred to consider costs in light of expected benefits. In their view, cost obstacles, while admittedly high for a developing country, could and should be overcome if the learning aids were proven effective.

There was general consensus on the need to evaluate learning aids on their overall impact, rather than simply in terms of their effects on lanuage and math test scores. Ease of maintenance, teacher and pupil reactions, supplementary material needs, training requirements, curricular relevance, as well as learning effects were among the issues for which data were considered crucial in making decisions.

Almost all administrators discounted negative teacher reaction as an insurmountable obstacle to the introduction of aids. Several administrators did acknowledge the possibility of unfavorable teacher attitudes toward learning aids, but felt that it could easily be changed through in-service training. Such training was also recognized as necessary for teachers to become skilled enough to take full advantage of the aids.

By contrast, considerable significance was attached to the need for a positive response by school managers. Gaining the favor of administrators was also considered problematic since they are the ones who must contend with the expenses of procuring and maintaining the aids and, at the building level, must assume responsibility for their safe storage. Administrators

were unanimous that pupil response to the learning aids would be so uniformly positive as to pose virtually no obstacle to their introduction.

Teachers and administrators agreed on the importance of the aids' relevance to the existing curriculum. An idea of what can happen when an innovation is perceived as a competing approach to a curricular goal is illustrated by the mild dismay expressed by math curriculum specialists over having to postpone the introduction of a "mental math" curriculum to test the Speak and Math. Although the potential usefulness of learning aids was recognized, their perceived incongruence with a program in which much effort had been invested led to a somewhat less enthusiastic response from these specialists.

On the question of where learning aids would best fit into the curriculum, almost all administrators saw their role as a supplement for drill and practice in regular English and Math classes. This drill and practice function was considered ideal for the remedial learning needs of weaker pupils or as an activity to occupy better pupils while teachers assisted weaker ones. However, reinforcement through drill and practice was viewed as having value only after the underlying concepts themselves had been mastered.

Like teachers, adminstrators found faults with several technical features of the learning aids. The mechanical-sounding voice, the imprecise pronunciaiton, and the unfamiliarity of the pre-programmed North American English vocabulary were among the most common reservations. Dependence on expensive alkaline batteries, instead of either solar rechargeable or carbon batteries, was also a drawback for cost-conscious administrators.

On balance, administrators found learning aids to be sufficiently

promising to justify more extensive testing, provided the results of the exploratory study indicated the likelihood of positive learning effects. Of particular interest was how learning aids would fare in a more varied cross-section of schools and whether interest in the aids would be sustained in schools where they have already been introduced. There might be more support for more extensive experiment, said some, now that resistance to educational applications of high technology seems to be rapidly disappearing. But individuals within this sample cautioned against underestimating the importance of cost obstacles to any massive investment in learning aids for primary schools.

Pupil Reactions

A sample of pupils was interviewed to determine reactions to the learning aids among the actual users. Twenty-three pupils, six from each of the test classes, were randomly selected as the sample. The interviews with these pupils were conducted in both English and Sesotho, with the assistance of interpreters. Reactions of pupils were sought on two specific issues:

1) the extent to which they knew about and accepted electronic learning aids, and

2) their preference regarding the way learning aids are used and the role of their teachers when the aids are being used.

Of the three populations affected by the learning aids (administrators, teachers, and pupils), pupils were by far the most enthusiastic in their reactions to the learning aids. All twenty-three of the pupils interviewed reported that they enjoyed using the aids. None said they had become bored with them. This was hardly unexpected given the extent to which children anywhere in the world seem captivated by technology such as this. The fact

that Basotho children are less exposed to such technology as American children seemed to heighten their enthusiasm.

Pupils tended to agree with each other on what they liked about the aids. First, the capacity of the aids to speak, to be held, to be easily used, and to improve their arithmetic and English skills was uniformly cited by pupils. Secondly, they recognized as helpful three features which teachers also cited: the immediate corrective feedback on answers, the visual display, and the beneficial effects of practice provided by the aids. The visual display was seen as an invaluable complement to the audio mode, particularly when the voice could not be heard or understood. Pupils mentioned that the aids helped them improve their spelling.

Users of the Speak and Read agreed on certain favorites among the programmed routines. "Picture Read" and "Word Zap" were liked the most because they were the "easiest." But pupils also indicated the desirability of having modules of varying levels of difficulty when the words and problems became too familiar. Indeed, almost half of the interviewees said that the words and problems presented by the aids were too easy.

Contrary to the reactions of their teachers, pupils saw a closer connection of the content in the aids with what was taught in class. Although most agreed that the aids did present unfamiliar words and problems, pupils found this to be a positive feature rather than a liability.

Few of the pupils could suspend their obvious enthusiasm long enough to express reservations about the learning aids. Those that did, however, criticized the use of standard American English words which differ from Lesotho English words in labeling certain objects or functions -- for example, van instead of kombi. Similarly, mention was made of the symbol

used for division in the Speak and Math (/) as opposed to that used in Lesotho English (%). Secondly, a few pupils disliked the randomness of the learning aid's presentation and the repetitiveness that resulted from such randomness. Finally, the low volume and tonal quality which presumably caused an occasional incomprehensibility of the voice were cited as additional problems with the aids.

Pupils expressed preference for using the aids in groups rather than individually. Of the twenty-three pupils interviewed, only six stated a preference for individual use. On the question of group size, five out of the twenty-three pupils did say that they would prefer three rather than four pupils per group. This is corroborated by the complaints of four of these same five pupils about not getting to use the aids as much as everyone else in their respective groups. Distraction was given as another reason for preferring smaller groups.

Despite the preference for smaller groups, cooperation in groups did occur frequently in the opinion of the respondents. All but two pupils said they worked cooperatively with the aids by helping others with problems or by allowing others to help them. It is impossible to know from these responses whether such assistance was expressly requested or was simply accepted as part of the on-going routine of using the learning aids. Observation data suggest that assistance was not usually solcited but given with the intention of hastening response time.

Pupil reaction to the amount of time with the aids proved interesting. The 45 minute period appeared satisfactory to a majority of pupils. Eight of the interviewees would have liked more time with the aids. However, a longer period of use was opposed by twelve other pupils. They believed a

shorter exposure was a stimulus to think and work faster and worried about the additional expense of batteries that might result from faster consumption. Nearly all pupils expressed a preference for not reducing the amount of time allocated to using aids.

Interviewee responses were divided on questions about what role teachers should play when the aids were being used. Most pupils felt the teacher should be in the class to supervise and to provide assistance when required. Indeed, all twenty-three pupils said that they had called on their teachers for help when there was a problem. But a few pupils did prefer that the teacher not supervise them, since some teachers inhibited the ability of individuals to use the aid effectively. In the opinion of this group, teachers were often prone to blurt out answers before pupils had a chance to figure them out for themselves.

It would be hard to conclude from the interviews that pupils did not enjoy using the aids. This data was corroborated by observation data previously discussed. The overwhelming enthusiasm of pupils and generally positive reaction to all aspects of their experience with the aids, however, should be regarded cautiously. The interviewing situation, with three adults present (including teachers), was not necessarily the best setting to guarantee pupil candor. The need for caution is illustrated by pupil opinion of the voice in the learning aid. Although most children denied that the pronunciation of the aid was a problem for them, actual observation and the opinions of some teachers appeared to suggest otherwise for a portion of pupils.

Conclusion

In terms of both the behavior they evoked and of the reactions they inspired among the principal participants, electronic learning aids appeared to have had a positive effect on the primary school classrooms in which they were tested. This conclusion seemed to follow from the composite picture of human use effects provided by a variety of data sources.

The use of the aids with small groups--an important condition for assuring cost-effectiveness in developing countries--proved to be successful. Pupils sustained a high degree of active engagement in the tasks presented by the learning aids, although a mild drop in engaged behavior was detected in groups using the aids for twelve weeks. While there were differences among pupils in the amount of time spent actually manipulating the aids, it was questioned whether this was necessarily indicative of differential benefits. Pupils also demonstrated a strong willingness to share the learning aids with others and stated their preference for such group use.

All three groups expressed generally favorable reactions to the aids. These ranged from cautious optimism, in the case of administrators, to unabashed enthusiasm on the part of pupils. Teachers, who generally reacted hesitantly at the beginning, were receptive as a group at the conclusion. Reservations held by some administrators and teachers were considered suggestive of a desire for further research rather than an uncompromising opposition to any future consideration.

Chapter V

LEARNING EFFECTS

It was beyond the scope of a pilot study such as this to identify the entire range of learning effects likely to be associated with using electronic learning aids in the classroom. Moreover, since the study was the first of its kind, there was no previous experience from which to define an instructional treatment to be compared to traditional instruction. What the study hoped to do was to look at how use of electronic aids affected two areas of pupil achievement. If the evidence suggested that using electronic aids positively influenced achievement in these two areas, a great deal would have been accomplished in determining the feasibility of using electronic aids in developing countries. In addition, this evidence would be important for helping define an instructional treatment for more refined testing at some future date.

Design

The two research questions guiding this part of the investigation were the following:

> Does an electronic learning aid like the Speak and Read help improve a pupil's ability to recognize English words?
>
> Does an electronic learning aid like the Speak and Math help improve a pupil's ability to solve addition, subtraction, multiplication, and division problems?

Four classes used the Speak and Read: one for twelve weeks, one for eight weeks, and two for four weeks. These classes 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.

Under ideal circumstances all evaluations of new educational interventions would involve the use of true experimental designs. True experimental designs, in the sense that Campbell and Stanley have described them, would allow one to say with certainty that a particular experimental manipulation is or is not having an effect.[1] True experimental designs require the random assignment of subjects to control and treatment conditions, and the establishment of control groups that are like treatment groups in every way except they do not receive the treatment of interest.

The conditions necessary for conducting true experiments are frequently not present in actual educational settings. This was certainly the case in Lesotho. Moreover, it is often the case, as it was in Lesotho, that the intact groups available for treatment and control comparisons are initially quite different in a number of critical ways, thereby making it impossible to determine if end of study differences are attributable to the treatment or to differences that existed before the study began.

Given these circumstances, the decision was made to utilize a "quasi-experimental" design to evaluate the hypothesis that the learning aids would positively affect the reading and arithmetic performance of the pupils who utilized them.[2] This design relied on the logic of plausibility rather than the logic of certainty available in true experimental designs. That is, assuming the pattern of results can be interpreted as indicating a positive impact of the aids, the design that was chosen would make every other rival interpretation of the results implausible.

The design that was chosen is a variant of a time-series design.[3] The idea was to test all of the groups participating in the experiment once a week for the entire course of the experiment. 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, and a third group did not use the arithmetic aids at all. This third group did have the opportunity of using the language aids throughout the experiment. In language, there was one group that used the language aid for the entire twelve-week period, a second group that used the aids for the last eight weeks of the experiment, a third and fourth group that utilized the aids for the last four weeks of the experiment, and a final group that did not use the learning aids at all.

If subjects were tested at regular intervals during the course of the experiment, evidence for the positive impact of the learning aids would be present if test performance began to improve at the point where pupils began to use the aids. Given that performance did increase in accordance with the introduction of the learning aids, any explanation other than positive impact of the aids would be extremely implausible.

The fact that the language learning aids instructed pupils on the decoding of a select set of words allowed the addition of a second type of evaluation of these aids. This was accomplished by weekly testing of pupils on words contained in the instructional set (I) and on words not contained in the instructional set (NI). Hence, evidence for the positive impact of the learning aids would be present if improvement on the instructed set of words coincided with the introduction of the learning aids and there was no corresponding improvement on the non-instructed set of words.

Procedures

Language

Pupils took a 20 minute test each week on English word recognition (the ability to translate written words into spoken words). The tests contained 50 items. The administrator of the test said a word, pupils indicated by marking with an "x" on the answer sheet "yes" or "no" whether the spoken word was the same as the written word. Half the words were instructed words (I), and half were non-instructed words (NI).

The instructed words were drawn from a list of 100 words selected from the 112 words of the Dolch Basic Sight Vocabulary List that are contained in the Speak and Read. The non-instructed words were drawn from a list of 100 words not contained in the Speak and Read. These included 30 words from the Dolch Basic Sight Vocabulary List (Preprimer, primer, and first grade levels) and 70 words from the Revised A and P Sight Word List (second, third, and fourth sets of 50 most frequently occurring words). It was necessary to use the A and P list in addition to the Dolch list because the Speak and Read exhausts most of the Dolch possibilities at the preprimer to first grade levels. The word lists and an example of the tests are contained in the Appendix E-1.

There were eight versions of the language test. The first three versions Tests 1-3 were administered twice as Tests 9-11. Tests 5-8 contained the same written words as Tests 1-4. However, the relationsip of the spoken words to the written words was reversed so that where they were identical in the first set of tests they became different in the second set and vice versa.

Specifications—Talking Learning Aids

	Speak & Read*	Speak & Math*	Speak & Spell*	Touch & Tell*
Learning Purpose	Reading drill	Math drill	Spelling drill	Basic vocabulary building
Grade Levels	Preschool–3rd	1st –6th	1st –8th	Preschool (ages 2-5)
Basic Operations	6 operations for building phonics, sight vocabulary and reading comprehension skills	5 operations for building skills in problem solving, reasoning and abstract concepts	5 operations for building spelling and word recognition skills	2 operations build vocabulary by identifying pictures when touched or by asking child to identify pictures
Expandable with plug-in modules	yes	no	yes	yes
Capacity	Over 250 words plus plug-in expandability	Over 100,000 random and preprogrammed problems	Over 150 words plus plug-in expandability	40 words, plus plug-in expandability
Levels of difficulty	3	3	4	Varies with different picture overlays.
Tries at correct answer	2	2	2	Infinite
Score given after	5 words	5 problems	10 words	N/A
Special functions/features	• 64 page activity book • Pronunciation/reading practice • Musical tones and verbal reinforcement • Earphone • Carry case	• 32-page activity book • Spoken problems • Greater than/less than practice • Practice in writing spoken numbers • Earphone	• 32-page activity book • Pronunciation practice • Musical tones and verbal reinforcement • Earphone	• 4 overlays (2 double-sided) • Verbal reinforcement • Sound effects • Learning library for modules • Parent's guide
Built-in learning games	2	1	3	N/A
APD automatic power down	yes	yes	yes	yes
Batteries	4-C cell (not included) Optional AC 9199 Adapter	4-C cell (not included) Optional AC 9199 Adapter	4-C cell (not included) Optional AC 9199 Adapter	2-D cell (not included)
Size (inches)	9.9 x 6.9 x 1.3	9.9 x 6.9 x 1.3	9.9 x 6.9 x 1.3	1.5 x 10.5 x 14
Weight (unit with batteries)	1.2 lbs.	1.2 lbs.	1.2 lbs.	2 lbs.

Appendix B-1

PARTICIPATING SCHOOLS

School:	Iketsetseng	Treatment:	Math-12 weeks begun 29 August
Location:	Maseru	Class:	Standard 6
Proprietor:	Private	Enrollment in Test Class:	50
Total Enrollment: (1982)	832	Teacher:	Mrs. Flo Kolobe Certificate PH LOS 17 Years
Pass Rate: (Primary School Leaving Exam 1982)	99%	Head Teacher:	Mrs. Mahahleha
Fees:	Over M 100	Advisors to Project:	Mrs. Noto and Mrs. Malikelle-members of the National Math Curriculum Panel
Enviroment:	Urban		
Facilities:	Excellent-electricity, well kept, good furniture		

School:	Hoohlo	Treatment:	Language-12 weeks begun 29 August
Location:	Maseru	Class:	Standard 4
Proprietor:	Anglican Church of Lesotho	Enrollment in Test Class:	53 pupils
Total Enrollment:	501	Teacher:	Mrs. Mabataung Tsephe Certificate APTC LOS- 5 years
Pass Rate: PSLE 82	78%	Head Teacher:	Mrs. Anna Matlosa
Fees:	M 58		
Enviroment:	Urban		
Facilities:	Fair-crowded, concrete floor, corrogated iron roof, noisy, no adequate furniture		

School: Morija LEC

Location: Murija

Proprietor: Lesotho Evangelical Church

Total Enrollment: 501

Pass Rate: PSLE 82 59%

Fees: M 58

Enviroment: Town of about 5,000 People

Facilities: Fair-crowding in lower standards, concrete floor, corroguated iron roof, adequate furniture, blackboards

Treatment: Math-8 weeks Beginning 26 September

Class: Standard 6

Enrollment in Test Class: 42 pupils

Teacher: Mr. Stephen Lemeke
Certificate LPTC 3 & JC
LOS 40 years

Head Teacher: Mrs. Maseretse

School: Masapong

Location: Masapong

Proprietor: Anglican Church

Total Enrollment: 328

Pass Rate: PSLE 82 95%

Fees: M 59

Enviroment: Rural

Facilities: Fair to Good--concrete floors, corroguated iron roof, sparse furniture, blackboards

Treatment: Language-8 weeks beginning 26 September

Class: Standard 4

Enrollment in Test Class: 29 pupils

Teacher: Mrs. Matseko Mochesane
School Head Teacher
Certificate JC (starting PTC at NTTC)
LOS 1 year

Head Teacher: Mr. Lucas Makuetje

School: O.B. Collins

Location: Rothe

Proprietor: African Methodist Church

Total Enrollment: 365

Pass Rate: PSLE 82 50%

Fees: M 49

Enviroment: 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 D-2.1

INTERVIEW SCHEDULE FOR TEACHERS *
AND TABULATED RESULTS

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

Y	6
N	

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?

Y	6
N	

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

Y	4
N	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?

Y	4
N	2

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

Y	4
N	2

i) in terms of curriculum

ii) scheduling

C	
S	

6B. If yes, how?

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

Y	5
N	1

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

Std.	
No.	

9. Does the use of the machines cause any discipline problems in class?

Y	2
N	4

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

Y	3
N	3

10B. If yes, at what standards?

11A. Do you think that the accent in the machine is a problem?

Y	5
N	1

* This interview schedule was prepared, conducted, and tabulated by M.S. Vijay Kumar.

11B. Do you think that understanding the accent is easier now than in the beginning?

Y	5
N	1

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

Y	6
N	–

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

E	6
S	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

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	3	4	2
No.	4	1	1

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

a) cooperative or	3
b) competitive	4

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

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?

Y	1
N	5

younger?	Y	
older?	0	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?

Y	
N	6

23. Do all the teachers in your school know how to use the machines?

Y	3
N	3

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 home?

Y	
N	6

27. Do you think it would be better to use these machines at home for practice/drill or in school?

H	
S	6

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?

Y	6
N	

30. Do the parents of the children know about the aids?

Y	6
N	

31. Do you know what they feel about the use of these aids?

Y	
N	

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

Y	6
N	

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

Y	6
N	

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?

Y	6
N	

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?	E	2
Subsidized?	S	4

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

R	5
U	6

Why?

* Wherever numbers exceed total numbers interviewed, there were multiple responses.

* Almost all the responses have been supported by a qualitative justification.

APPENDIX D-3.1

INTERVIEW SCHEDULE FOR ADMINISTRATORS *
AND TABULATED RESULTS

NAME:_____ TITLE/POSITION:_____

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

Yes	7

No	

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

a. Language:

a. High	5
b. Medium	1
c. Low	

b. Arithmetic:

a. High	6
b. Medium	1
c. Low	

3. Have you had a chance to see the electronic learning aids?

Yes	7

No	

4. Have you had a chance to see the aids being used in a class?

Yes	3

No	4

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

Yes	6

No	1

* This interview schedule was prepared, conducted, and tabulated by M.S. Vijay Kumar.

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

Yes	6

No	–

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).

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 (HA)
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

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

S	5
E	7

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 aides 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:

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

yes	5	no	1

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

* 2 abstained.

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

18. a) How do you think these aids would fit best 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)	

18. b) 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)	

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: 1) DIFFICULT (D), 2) MANAGEABLE (M), 3) DIFFICULT BUT WORTHWHILE (DBW), 4) EASY (E), 5) NOT AN OBSTACLE AT ALL (NO)

		D	M	DBW	E	NO
19. 1)	Initial Procurement costs	3	1	3		
19. 2)	Maintenance lists (recurrent: battery expenses, replacements, storage)	5	1		1	
19. 3)	Retraining of teachers	1	1	1	2	1
19. 4)	Rescheduling of school operations (classes, periods, etc.	1	1			5

		D	M	DBW	E	NO
19. 5)	Parents' attitudes towards use	1	1	1	1	3
19. 6)	Teachers' attitudes towards use	1	2	1	1	2
19. 7)	Children's attitudes towards use					7
19. 8)	Administrators' attitudes towards use	4	1	1		1
19. 9)	Ability to develop materials to support the use of these aids	4	2			1

		D	M	DBW	E	NO
19. 10)	Issues of maintenance; storage, breakage, replacements, batteries, etc.	4	1	1		1
19. 11)	Ability to provide the aids to all schools	5	1	1		
19. 12)	Projected size of school enrollments	3	1	1	1	1
19. 13)	Ability to evaluate if the aids are really useful	2	1		1	3
19. 14)	Schools' ability to continue use of these aids over time	3	2			

	D	M	DBW	E	NO
19. 15) Any others (Please list					

APPENDIX D-4.1

INTERVIEW SCHEDULE FOR PUPILS*
AND TABULATED RESULTS

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? 12/11

2. What subjects do they help you in?

S	E	M
N	12	12

3. Do you like using these aids?

Y	23
N	-
I	-

(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?	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?

*This interview was prepared, conducted, and tabulated by M.S. Vijay Kumar.

6A. Are the words that the aids give you

too easy	6
or	
too difficult	
or	
about right	5

6B. Are the problems that the aids give you

too easy	5
or	
too difficult	1
or	
about right	6

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

Y	21
N	2

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

Y	16
N	2

9A. Is understanding the pronounciation and hearing the aids better now than in the beginning?

Y	21
N	2

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 least?

11B. Why?

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

3 - 5

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

a) too much	5
b) too few	
c) just right	1

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

Y	19
N	4

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

Y	19
N	2

2 - No Comment

16. Do you help them?

Y	22
N	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?

G	15
A	6

2 - No response

19. Do you like keeping scores when working with the aids?

Y	22
N	1

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

Y	12
N	8

3 - No response

20B. Would you like more time?

Y	8
N	12

20C. Would you like less time?

Y	
N	20

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

B	5
AS	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?

Y	23
N	-

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

25A. Do you like taking the tests?

Y	21
N	-

2 - No response

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?

Y	17*
N	1

5 - No response

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

Y	-
N	23

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

Y	12
N	-

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

Y	11
N	-

28. Do you think that it would be a good idea for other children, in your school and elsewhere, to be using these aids?

Y	22*
N	-

1 - No response

17 - Other Schools

5 - Only our school, b[illegible]

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

gv

TEST WORDS INSTRUCTED

1. all
2. am
3. as
4. at
5. back
6. backwards
7. bad
8. bags
9. bird
10. brown
11. but
12. call
13. camp
14. can
15. cat
16. cats
17. bats
18. dad
19. damp
20. did
21. do
22. down
23. falls
24. fan
25. fast
26. fat
27. father
28. go
29. goat
30. green
31. hand
32. hat
33. her
34. hit
35. home
36. I
37. it
38. jam
39. know
40. like
41. little
42. look
43. mad
44. maps
45. mat
46. may
47. naps
48. no
49. numbers
50. of
51. one
52. orange
53. out
54. oven
55. pan
56. pink
57. play
58. pretty
59. purple
60. rake
61. ram
62. ran
63. rat
64. red
65. sad
66. sleep
67. soon
68. tack
69. take
70. tall
71. that
72. then
73. this
74. top
75. trip
76. try
77. two
78. under
79. unhappy
80. us
81. van
82. wag
83. wall
84. went
85. were
86. which
87. word
88. wrong
89. you
90. your
91. animals
92. four
93. dog
94. [illegible]
95. how
96. land
97. new
98. yellow
99. jump
100. the

Appendix E-1

TEST WORDS NON-INSTRUCTED

1. find
2. help
3. ate
4. into
5. must
6. our
7. please
8. say
9. again
10. any
11. ask
12. by
13. could
14. every
15. fly
16. give
17. going
18. his
19. just
20. live
21. old
22. once
23. round
24. some
25. them
26. think
27. well
28. walk
29. who
30. open
31. other
32. word
33. water
34. people
35. time
36. than
37. use
38. day
39. air
40. sound
41. same
42. through
43. place
44. another
45. name
46. children
47. house
48. mother
49. asked
50. picture
51. most
52. always
53. around
54. because
55. been
56. before
57. best
58. both
59. bug
60. cold
61. does
62. first
63. gave
64. goes
65. its
66. made
67. many
68. off
69. or
70. pull
71. right
72. sing
73. sit
74. tell
75. their
76. these
77. those
78. upon
79. use
80. very
81. wash
82. why
83. work
84. write
85. part
86. story
87. keep
88. need
89. boy
90. last
91. along
92. men
93. even
94. night
95. line
96. sun
97. food
98. cut
99. pick
100. start

NAME _____ School _____

1.	BAD	yes	no
2.	HAND	yes	no
3.	PLEASE	yes	no
4.	WELL	yes	no
5.	AS	yes	no
6.	HOUSE	yes	no
7.	PAN	yes	no
8.	RIGHT	yes	no
9.	FLY	yes	no
10.	SOON	yes	no
11.	DAMP	yes	no
12.	WALL	yes	no
13.	KEEP	yes	no
14.	ATE	yes	no
15.	HOW	yes	no
16.	PLACE	yes	no
17.	LINE	yes	no
18.	WORK	yes	no
19.	BUT	yes	no
20.	THEIR	yes	no
21.	TRIP	yes	no
22.	MADE	yes	no
23.	ALONG	yes	no
24.	ROUND	yes	no
25.	BUG	yes	no
26.	HOME	yes	no
27.	RAT	yes	no
28.	TIME	yes	no
29.	ONE	yes	no
30.	MOST	yes	no
31.	GAVE	yes	no
32.	CAT	yes	no
33.	UNHAPPY	yes	no
34.	PURPLE	yes	no
35.	ASK	yes	no
36.	USE	yes	no
37.	JUST	yes	no
38.	THAT	yes	no
39.	AIR	yes	no
40.	MANY	yes	no
41.	FALLS	yes	no
42.	JUMP	yes	no
43.	WORD	yes	no
44.	KNOW	yes	no
45.	BEEN	yes	no
46.	PICK	yes	no
47.	ANIMALS	yes	no
48.	OTHER	yes	no
49.	NAPS	yes	no
50.	FATHER	yes	no

%
%
%

Appendix E-2

TEST 10

NAME _____ SCHOOL _____

1. 71 + 57 =
2. 7 x 2 =
3. 887 - 292 =
4. 45 ÷ 15 =
5. 99 - 85 =
6. 512 ÷ 64 =
7. 3 + 6 =
8. 7 + 7 =
9. 79 - 34 =
10. 42 x 456 =
11. 65 ÷ 13 =
12. 8 - 7 + 1 =
13. 930 + 335 =
14. 10 x 81 =
15. 42 ÷ 7 =
16. 62 + 67 =
17. 2025 ÷ 45 =
18. 5 + 1 - 4 =
19. 35 - 17 =
20. 73 x 25 =
21. 383 + 797 =
22. 47 x 61 =
23. 8 + 3 =
24. 689 - 94 =
25. 12 + 26
26. 180 ÷ 3 =
27. 9 x 4 =
28. 48 - 34 =
29. 637 x 63 =
30. 918 ÷ 34 =
31. 9 - 6 =
32. 24 + 43 =

Appendix E-3

Correlation of Scores on Math Tests

	TEST1	TEST2	TEST3	TEST4	TEST5	TEST6	TEST7	TEST8	TEST9	TEST10	TEST11
TEST1	1.0000										
TEST2	0.6508	1.0000									
TEST3	0.6684	0.7171	1.0000								
TEST4	0.5795	0.7161	0.7599	1.0000							
TEST5	0.5522	0.7394	0.7019	0.7463	1.0000						
TEST6	0.6149	0.6827	0.7269	0.7459	0.7777	1.0000					
TEST7	0.5889	0.7627	0.7151	0.7337	0.8031	0.7702	1.0000				
TEST8	0.4452	0.6307	0.5989	0.6569	0.7273	0.6198	0.6666	1.0000			
TEST9	0.5814	0.7496	0.7007	0.7518	0.8000	0.7291	0.7914	0.7030	1.0000		
TEST10	0.5567	0.6914	0.6705	0.6801	0.7577	0.7436	0.7326	0.7012	0.8474	1.0000	
TEST11	0.6281	0.7350	0.7574	0.7409	0.7708	0.7291	0.7654	0.6906	0.8112	0.7961	1.0000

Appendix E-3
Correlation of Scores
on Language Tests

Instructed Words

FIRST ORDER CORRELATION MATRIX

	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11
I1	1.0000										
I2	0.3149	1.0000									
I3	0.3972	0.5329	1.0000								
I4	0.3436	0.6456	0.6626	1.0000							
I5	0.3175	0.7051	0.6593	0.6685	1.0000						
I6	0.4936	0.5152	0.5944	0.6286	0.6610	1.0000					
I7	0.4011	0.6524	0.6550	0.5621	0.7624	0.6102	1.0000				
I8	0.4641	0.6046	0.5986	0.5760	0.7181	0.5634	0.7080	1.0000			
I9	0.3201	0.5570	0.5131	0.4669	0.6808	0.5341	0.6845	0.7089	1.0000		
I10	0.2338	0.5610	0.5841	0.4002	0.7105	0.4336	0.7262	0.7662	0.7380	1.0000	
I11	0.3847	0.4967	0.5782	0.5334	0.6424	0.5708	0.6506	0.7205	0.6334	0.7360	1.0000

Non-Instructed Words

	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11
N1	1.0000										
N2	0.3646	1.0000									
N3	0.3032	0.5703	1.0000								
N4	0.3590	0.6274	0.6122	1.0000							
N5	0.4524	0.6814	0.5981	0.6658	1.0000						
N6	0.4264	0.5320	0.6710	0.6929	0.6874	1.0000					
N7	0.4366	0.4374	0.4898	0.5259	0.6365	0.6529	1.0000				
N8	0.2922	0.6095	0.5002	0.5272	0.6002	0.6114	0.5220	1.0000			
N9	0.3274	0.5314	0.5237	0.6177	0.5480	0.6849	0.6672	0.6233	1.0000		
N10	0.3067	0.4849	0.4925	0.5432	0.5485	0.6917	0.6033	0.7159	0.7699	1.0000	
N11	0.3373	0.5039	0.4573	0.5617	0.6471	0.6939	0.5397	0.7076	0.7273	0.7391	1.0000

Appendix E-4

DESCRIPTIVE STATISTICS HOOHLO - Standard 4 (12 weeks) : Instructed Words

TEST	N	MIN.	MAX.	RANGE	MEAN	VARIANCE	ST. DEV.	ST. ERR.
I1!	50	11	23	12	15.900	9.724	3.1184	0.4410
I2!	53	8	25	17	17.792	15.629	3.9534	0.5430
I3!	53	9	24	15	18.642	9.581	3.0952	0.4252
I4!	52	11	24	13	18.000	10.275	3.2054	0.4445
I5!	51	11	24	13	19.392	9.643	3.1053	0.4348
I6!	53	12	24	12	17.925	9.725	3.1185	0.4284
I7!	50	12	24	12	18.840	8.749	2.9579	0.4183
I8!	53	11	24	13	18.151	10.477	3.2368	0.4446
I9!	51	10	25	15	19.941	9.656	3.1075	0.4351
I10!	47	11	25	14	21.340	9.099	3.0165	0.4400
I11!	53	13	25	12	21.377	8.124	2.8503	0.3915

DESCRIPTIVE STATISTICS Non-Instructed Words

TEST	N	MIN.	MAX.	RANGE	MEAN	VARIANCE	ST. DEV.	ST. ERR.
N1!	50	10	24	14	16.780	11.808	3.4362	0.4860
N2!	53	5	25	20	18.415	15.209	3.8999	0.5357
N3!	53	9	24	15	19.830	10.759	3.2801	0.4506
N4!	52	11	25	14	19.154	10.956	3.3100	0.4590
N5!	51	10	23	13	18.137	8.961	2.9935	0.4192
N6!	53	12	24	12	19.396	9.475	3.0781	0.4228
N7!	50	11	23	12	16.960	8.570	2.9274	0.4140
N8!	53	11	24	13	19.075	10.071	3.1735	0.4359
N9!	51	11	25	14	21.275	12.483	3.5331	0.4947
N10!	47	12	24	12	20.021	8.630	2.9377	0.4285
N11!	53	11	25	14	21.415	8.747	2.9576	0.4063

MASAPONG - Standard 4 (8 weeks) Instructed Words

TEST	N	MIN.	MAX.	RANGE	MEAN	VARIANCE	ST. DEV.	ST. ERR.
I1!	32	5	23	18	14.000	12.065	3.4734	0.6140
I2!	31	9	25	16	20.065	17.396	4.1708	0.7491
I3!	25	14	25	11	20.440	10.340	3.2156	0.6431
I4!	31	11	23	12	18.419	11.985	3.4619	0.6218
I5!	29	11	24	13	20.414	11.680	3.4176	0.6346
I6!	27	8	23	15	16.778	13.103	3.6197	0.6966
I7!	28	13	25	12	19.500	8.926	2.9876	0.5646
I8!	25	14	23	9	18.840	5.973	2.4440	0.4888
I9!	28	17	24	7	21.214	3.212	1.7921	0.3387
I10!	31	15	25	10	22.032	6.299	2.5098	0.4508
I11!	31	14	25	11	21.452	6.256	2.5012	0.4492

DESCRIPTIVE STATISTICS Non-Instructed Words

TEST	N	MIN.	MAX.	RANGE	MEAN	VARIANCE	ST. DEV.	ST. ERR.
N1!	32	4	23	19	14.906	16.991	4.1220	0.7287
N2!	31	11	24	13	20.097	13.957	3.7359	0.6710
N3!	25	10	25	15	20.720	15.877	3.9846	0.7969
N4!	31	7	24	17	19.065	15.396	3.9237	0.7047
N5!	29	13	24	11	18.966	10.320	3.2125	0.5965
N6!	27	12	23	11	18.667	7.769	2.7873	0.5364
N7!	28	12	23	11	18.250	11.009	3.3180	0.6270
N8!	25	17	25	8	21.400	4.917	2.2174	0.4433
N9!	28	16	25	9	22.357	4.608	2.1467	0.4057
N10!	31	15	24	8	21.258	4.131	2.0325	0.3651
N11!	31	14	25	9	21.613	4.445	2.1084	0.3787

DESCRIPTIVE STATISTICS O.B. COLLINS - Standard 4 (4 weeks): Instructed Words

TEST	N	MIN.	MAX.	RANGE	MEAN	VARIANCE	ST. DEV.	ST. ERR.
I1!	28	12	16	4	12.464	1.073	1.0357	0.1957
I2!	28	13	24	11	17.929	10.291	3.2080	0.6062
I3!	31	11	21	10	17.258	6.131	2.4761	0.4447
I4!	32	9	21	12	16.437	7.996	2.8277	0.4999
I5!	32	11	22	11	16.906	12.088	3.4767	0.6146
I6!	28	9	19	10	14.929	6.661	2.5810	0.4878
I7!	28	6	22	16	16.500	12.333	3.5119	0.6637
I8!	29	7	22	15	16.276	8.635	2.9386	0.5457
I9!	29	14	23	9	19.241	6.118	2.4735	0.4593
I10!	31	5	25	20	18.613	20.245	4.4995	0.8081
I11!	31	12	22	10	18.161	6.873	2.6217	0.4709

DESCRIPTIVE STATISTICS Non-Instructed Words

TEST	N	MIN.	MAX.	RANGE	MEAN	VARIANCE	ST. DEV.	ST. ERR.
N1!	28	13	18	5	13.679	2.671	1.6342	0.3088
N2!	28	11	22	11	17.964	13.147	3.6259	0.6852
N3!	31	12	23	11	19.548	9.523	3.0859	0.5542
N4!	32	11	23	12	17.500	12.387	3.5195	0.6222
N5!	32	10	22	12	17.062	11.028	3.3209	0.5871
N6!	28	11	23	12	18.071	11.698	3.4203	0.6464
N7!	28	9	21	12	14.714	9.249	3.0412	0.5747
N8!	29	4	24	20	17.759	17.261	4.1546	0.7715
N9!	29	10	24	14	19.724	11.921	3.4527	0.6412
N10!	31	11	25	14	18.548	16.123	4.0153	0.7212
N11!	31	10	25	15	19.806	11.161	3.3409	0.6000

DESCRIPTIVE STATISTICS O.B. COLLINS - Standard 3 (4 weeks): Instructed Words

TEST	N	MIN.	MAX.	RANGE	MEAN	VARIANCE	ST. DEV.	ST. ERR.
I1!	0							
I2!	0							
I3!	0							
I4!	0							
I5!	0							
I6!	37	8	18	10	13.243	4.911	2.2162	0.3643
I7!	42	7	19	12	14.143	6.955	2.6372	0.4069
I8!	38	10	19	9	14.211	5.792	2.4067	0.3904
I9!	39	9	21	12	15.667	11.070	3.3272	0.5328
I10!	44	8	24	16	16.159	19.904	4.4614	0.6726
I11!	43	10	24	14	17.233	16.897	4.1106	0.6269

DESCRIPTIVE STATISTICS Non-Instructed Words

TEST	N	MIN.	MAX.	RANGE	MEAN	VARIANCE	ST. DEV.	ST. ERR.
N1!	0							
N2!	0							
N3!	0							
N4!	0							
N5!	0							
N6!	37	10	19	9	14.838	5.251	2.2915	0.3767
N7!	42	9	17	8	13.024	4.414	2.1010	0.3242
N8!	38	10	22	12	16.368	9.050	3.0083	0.4880
N9!	39	7	22	15	15.333	13.386	3.6587	0.5859
N10!	44	10	24	14	15.273	13.226	3.6368	0.5483
N11!	43	9	25	16	17.209	18.979	4.3565	0.6644

DESCRIPTIVE STATISTICS IKETSETSENG - Standard 4 (Control): Instructed Words

TEST	N	MIN.	MAX.	RANGE	MEAN	VARIANCE	ST. DEV.	ST. ERR.
I1!	131	7	25	18	17.000	17.400	4.1713	0.3645
I2!	130	9	25	16	19.277	17.954	4.2372	0.3716
I3!	129	4	25	21	19.434	15.232	3.9028	0.3436
I4!	130	4	25	21	18.431	18.030	4.2462	0.3724
I5!	128	2	24	22	18.273	13.413	3.6624	0.3237
I6!	0							
I7!	128	4	25	21	18.320	16.408	4.0507	0.3580
I8!	0							
I9!	127	2	25	23	19.276	15.566	3.9454	0.3501
I10!	0							
I11!	126	7	25	18	19.714	14.414	3.7965	0.3382

DESCRIPTIVE STATISTICS Non-Instructed Words

TEST	N	MIN.	MAX.	RANGE	MEAN	VARIANCE	ST. DEV.	ST. ERR.
N1!	131	5	25	20	17.618	20.653	4.5446	0.3971
N2!	131	4	25	21	18.550	19.665	4.4345	0.3874
N3!	129	2	25	23	19.450	18.859	4.3427	0.3824
N4!	130	1	25	24	18.754	20.171	4.4913	0.3939
N5!	128	3	25	22	18.633	16.439	4.0545	0.3584
N6!	0							
N7!	126	7	25	18	17.937	18.957	4.3539	0.3848
N8!	0							
N9!	127	8	25	17	20.488	16.204	4.0254	0.3572
N10!	0							
N11!	126	9	25	16	20.310	14.183	3.7661	0.3355

Appendix E-5

Table ???

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

Masapong - Standard 4 (8 weeks)

Test	Instructed	Non-Instructed
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)

Test	Instructed	Non-Instructed
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

O.B. Collins - Standard 3 (4 weeks)

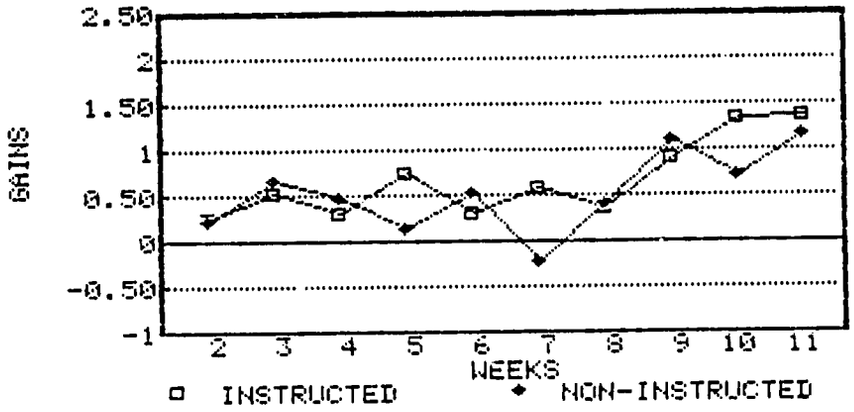
Test	Instructed	Non-Instructed
2	-	-
3	-	-
4	-	-
5	-	-
6	-	-
7	.41	-.79
8	.44	.67
9	1.10	.22
10	1.30	.19
11	1.80	1.00

Iketsetseng - Standard 4 (Control)

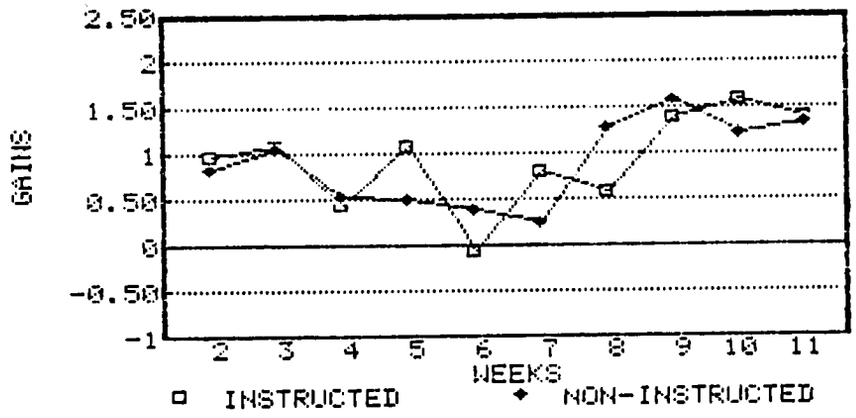
Test	Instructed	Non-Instructed
2	.30	.11
3	.34	.33
4	.08	.16
5	.04	.14
6	-	-
7	.05	-.03
8	-	-
9	.30	.58
10	-	-
11	.42	.54

Appendix E-6

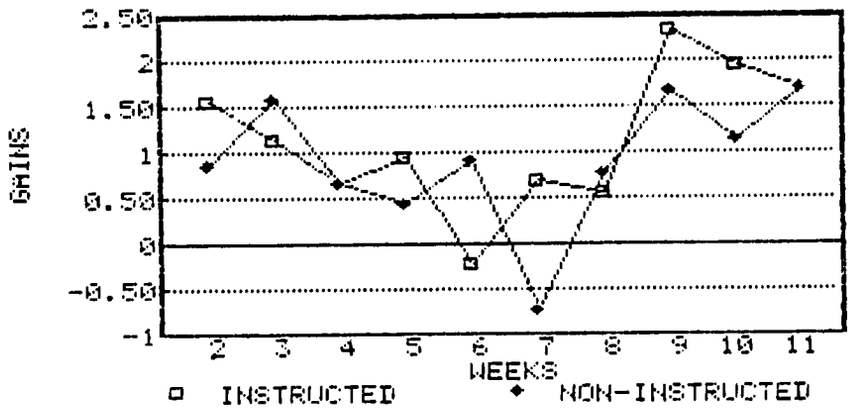
HOOHLO



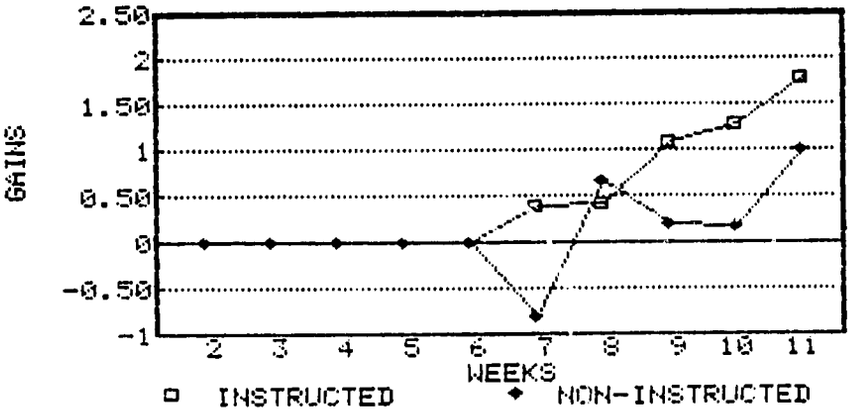
MASAPONG



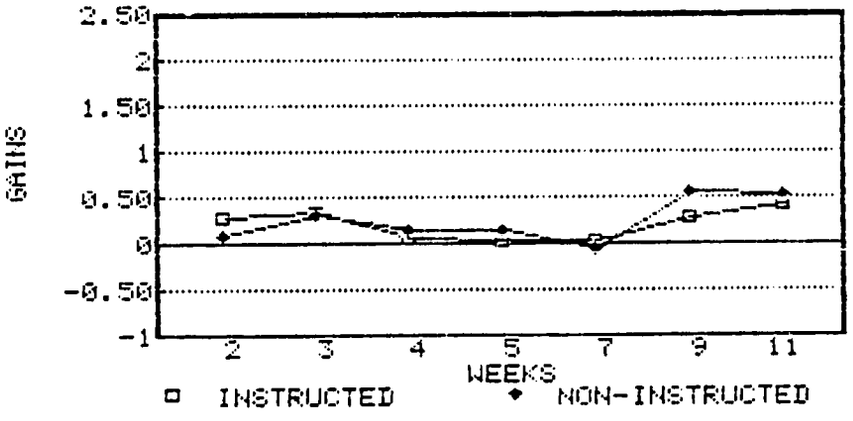
O.B. COLLINS IV



O.B. COLLINS STANDARD III



IKETSETSENG



Appendix E-7

DESCRIPTIVE STATISTICS - IKETSETSENG - Standard 6 (12 weeks)

VARIABLE!	N	MIN.	MAX.	RANGE	MEAN	VARIANCE	ST. DEV.	ST. ERR.
TEST1!	49	10	28	18	20.408	20.997	4.5822	0.6546
TEST2!	50	11	27	16	18.480	11.887	3.4478	0.4876
TEST3!	50	13	28	15	21.060	12.017	3.4665	0.4902
TEST4!	50	13	29	16	21.900	11.276	3.3579	0.4749
TEST5!	48	11	30	19	19.187	20.453	4.5225	0.6528
TEST6!	49	10	31	21	18.735	16.491	4.0609	0.5801
TEST7!	50	10	30	20	20.260	19.584	4.4254	0.6258
TEST8!	48	11	45	34	21.729	32.712	5.7195	0.8255
TEST9!	48	13	31	18	22.750	25.170	5.0170	0.7241
TEST10!	50	14	32	18	23.680	18.998	4.3586	0.6164
TEST11!	47	15	30	15	22.574	18.424	4.2923	0.6261

DESCRIPTIVE STATISTICS - MORIJA - Standard 6 (8 weeks)

VARIABLE!	N	MIN.	MAX.	RANGE	MEAN	VARIANCE	ST. DEV.	ST. ERR.
TEST1!	41	4	26	22	15.902	28.090	5.3000	0.8277
TEST2!	41	3	22	19	15.073	14.120	3.7576	0.5868
TEST3!	41	11	25	14	18.805	12.711	3.5652	0.5568
TEST4!	40	7	26	19	18.100	21.887	4.6784	0.7397
TEST5!	41	7	24	17	16.293	15.262	3.9067	0.6101
TEST6!	39	5	24	19	16.026	17.710	4.2083	0.6739
TEST7!	41	4	26	22	16.585	23.099	4.8061	0.7506
TEST8!	39	7	28	21	18.154	22.818	4.7768	0.7649
TEST9!	41	5	28	23	19.654	26.178	5.1164	0.7991
TEST10!	41	7	29	22	21.000	20.850	4.5662	0.7131
TEST11!	40	10	27	17	19.450	17.433	4.1753	0.6602

DESCRIPTIVE STATISTICS - HOOHLO - Standard 6 (Control)

VARIABLE!	N	MIN.	MAX.	RANGE	MEAN	VARIANCE	ST. DEV.	ST. ERR.
TEST1!	67	5	28	23	16.269	26.806	5.1774	0.6325
TEST2!	67	6	26	20	16.552	19.281	4.3911	0.5365
TEST3!	69	9	28	19	19.029	22.176	4.7091	0.5669
TEST4!	67	6	28	22	19.388	29.332	5.4159	0.6617
TEST5!	66	6	28	22	16.045	25.706	5.0701	0.6241
TEST6!	66	5	27	22	15.061	27.289	5.2238	0.6430
TEST7!	61	3	29	26	17.459	31.252	5.5904	0.7158
TEST8!	65	6	29	23	19.185	27.247	5.2198	0.6474
TEST9!	66	6	32	26	18.439	31.789	5.6381	0.6940
TEST10!	67	7	30	23	20.015	26.500	5.1478	0.6289
TEST11!	67	6	30	24	19.075	25.797	5.0791	0.6205

Appendix E-8

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)

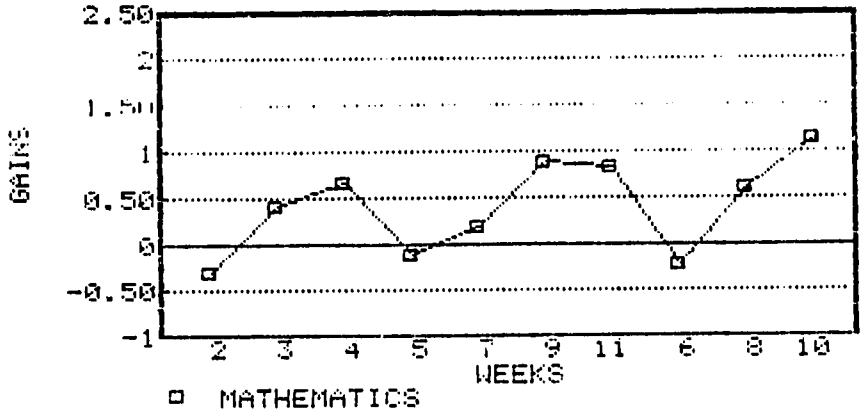
Test	Score
2	-.10
3	.83
4	.65
5	.20
6	.13
7	.27
8	.66
9	1.08
10	1.37
11	.98

Hoohlo - Standard 6 (Control)

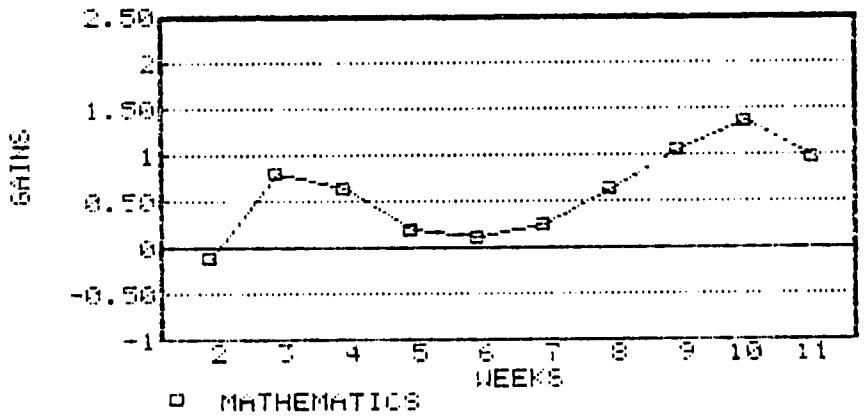
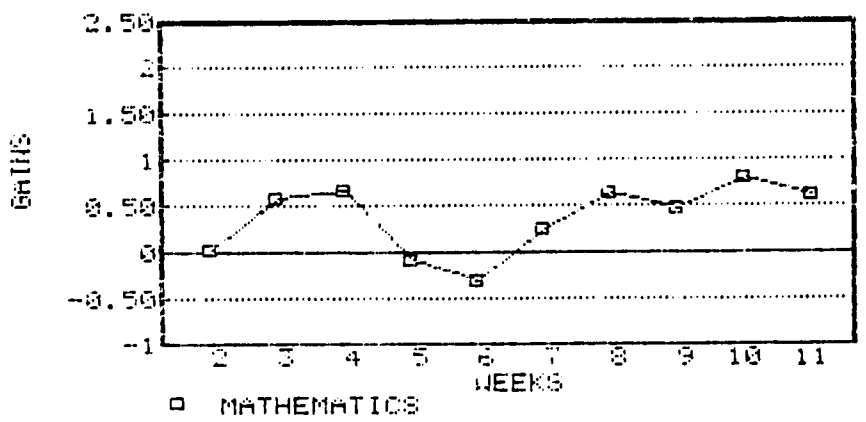
Test	Score
2	.05
3	.61
4	.69
5	-.06
6	-.29
7	.26
8	.65
9	.48
10	.83
11	.62

Appendix E-9

IKETSETSENG



MORIJA - STANDARD 6



HOOHLO - STANDARD 6