LIBERIA

Background Papers on Liberian Educational Development

October 1986

IEES

Improving the Efficiency of Educational Systems

Florida State University
Howard University
Institute for International Research
State University of New York at Albany

United States Agency for International Development
Bureau for Science and Technology
Office of Education
Contract No. DPE-5283-C-00-4013-00

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Office of Education
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I

Accommodation or Competition? The IEL and Fourth World Bank Education Projects

Conrad W. Snyder, Jr.
and
John A. Richard

Ministry of Education

December 1984

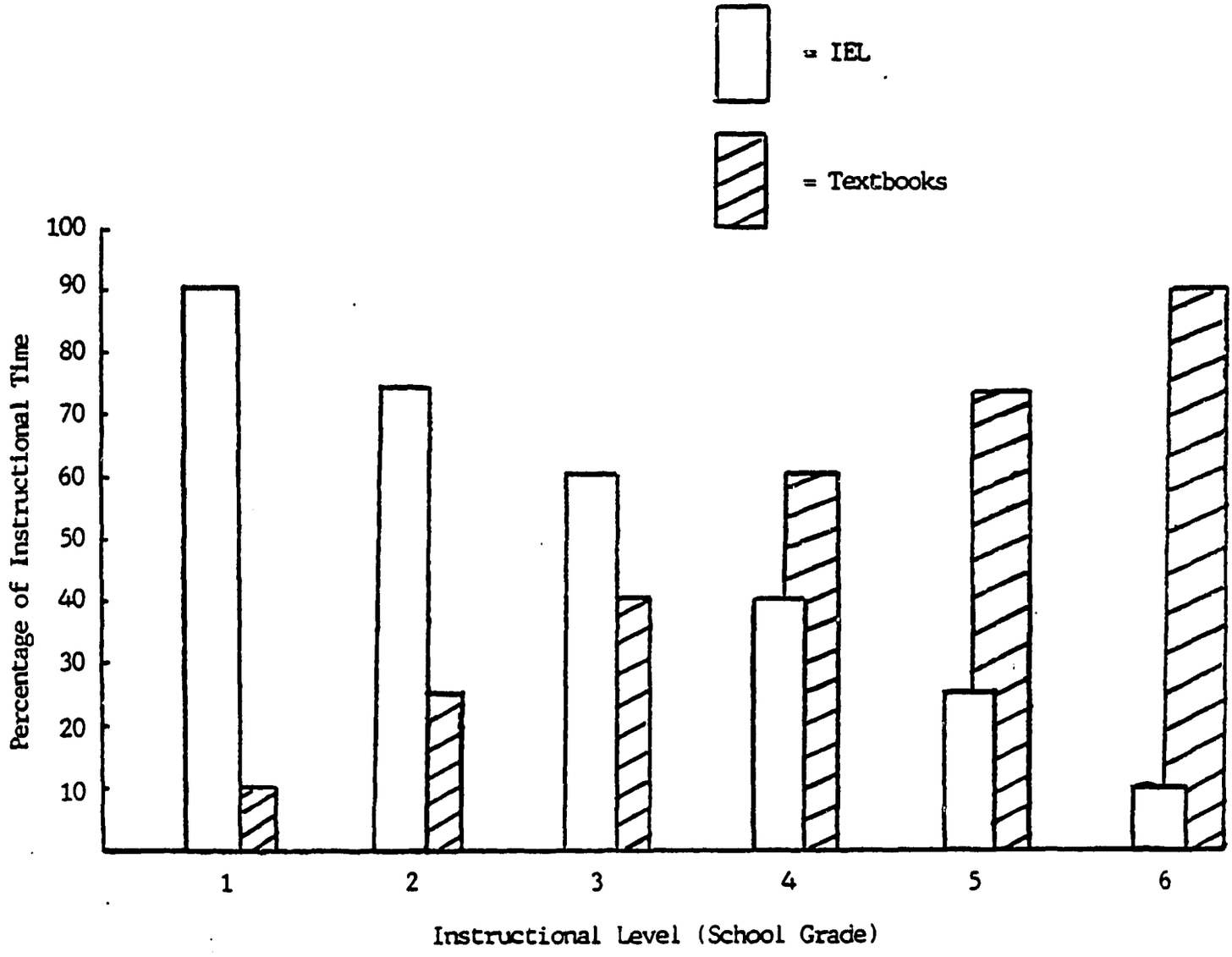
ACCOMMODATION OR COMPETITION?

PROPOSED AMALGAMATION OF IEL AND WB-4 (IN BRIEF)

The optimum solution to the amalgamation of the IEL and textbook-based systems must exploit the benefits of each of these approaches. IEL is a highly structured instructional teaching system, depending little on the "teaching" skills of the teacher; the textbook-based scheme is less structured (actually textbooks are highly structured also, but their use is not), depending far more on translation by the teacher into classroom and assignment activities. An appropriate recommendation for some combination of these programs could well entail the use of the highly structured, easily-followed IEL system at the lower levels of elementary education, with decreasing use of "programming" as students move up the grade levels. This means that IEL would be emphasized in the early grades, with textbooks becoming the dominate approach by the end of elementary school, particularly since post-primary education utilizes textbooks almost exclusively (theoretically). An illustrative program division across grades is depicted in Exhibit 1.

The timing of the amalgamation of these instructional systems is important so that immediate needs are met as well as future needs. WB-4 is actively distributing textbooks for the elementary schools (both public and private) throughout the country; IEL has engaged in limited production and distribution of materials to schools which have adopted the IEL approach (now 45 schools in 7 counties). IEL cannot immediately respond to the need for instructional materials across the entire elementary system, so the immediate focus of the MOE is on the WB-4 project. The MOE has invested

EXHIBIT 1.



RELATIVE EMPHASES OF IEL AND TEXTBOOK-BASED INSTRUCTIONAL SYSTEMS

Note: These percentages are illustrative only of emphases; appropriate figures will depend upon technical considerations.

considerable resources in the textbook project (remembering that WB-4 is funded as an IBRD/IDA loan), and textbooks can at least partially meet one of the immediate needs of the educational system. IEL can best benefit Liberia by becoming part of the middle-term solution to the low-quality instructional program of Liberian schools. This means that the MOE will emphasize textbook distribution and utilization over the next few years while the technical, supervisory, and administrative accommodation of IEL is planned and implemented.

A further consideration is the defensive stance taken (or likely to be taken) by Liberian educators against "programming". Hints of this problem have existed as far back as the MOE reactions to the original IEL project paper. Little attention was paid to these concerns because IEL was an "experiment" and the appropriate emphasis was given to the development of an effective intervention program. The emphasis on effectiveness precluded to a large extent concern for accommodation with the (perceived ineffective) existing system. Presently, there appear to be two levels of concern about IEL. The first is semantic; that is, some critics respond cautiously or negatively to the connotative loading of "programming" rather than to any specific IEL operationalization of that term. But, the second concern is substantive. The IEL system is tightly constrained, particularly the "programmed teaching" (PT) modules aimed at the early grades. Over the long-term, IEL could conceivably become the dominate instructional approach of the school system as more and more schools voluntarily accept its implementation. However, USAID indicates it's not interested in a fringe program, and the MOE cannot support national implementation without the

mutual accommodation of the innovative and extant systems. This means that IEL will need to loosen its "programming" to allow for teacher initiatives and to facilitate textbook integration. Since IEL has demonstrated its instructional effectiveness, this unbundling should be designed to retain the integrity and efficiency of the IEL system.

RATIONALE FOR THE ACCOMMODATION OF IEL

1. Children in Grades 1 to 3 (particularly) require a strong foundation in basic reading, language, and mathematics. This gives them a basis for successfully using a variety of materials in later grades and will benefit them throughout their academic career. Structured materials and methods will meet this critical need more consistently and effectively than reliance on textbooks alone. Children in these grades do not have the necessary entry-level skills to read and benefit from textbooks. A structured classroom does not require the children to rely on already developed reading skills. Also, a less structured textbook-based classroom relies on higher-level teaching skills, such as preparing lessons, translating text material into learning activities, and supplementing content with skill training. Structured activities do not require such complex, inter-related, teacher-generated activities and are structually designed to attend to individual problems which inevitably arise with young students.

2. Most teachers in the lower grades are unqualified and underqualified. According to staff at the RTTI's, even graduates from these

institutions, which serve the elementary system, are underqualified. More structure is better suited to the limited skills of available teachers. The IEL Project has packaged workshops and supervisory support which can provide further in-service training for teachers in these structured activities.

3. Many elementary schools in Liberia have multi-grade classes. Multiple grades require considerable management, which is unlikely to occur unless a structured program is available. IEL has already developed the management system for such classes.

4. The highest enrollment in the school system naturally occurs at the lower grades. Textbooks are not available for every elementary school student, and it is doubtful that they would be bought even if they were available. Costs to the family must be kept at a minimum at this level to encourage continuation of the students in the school system. Cost-effectiveness is an important consideration throughout the system, but it is even more critical at the lower levels. As Windham's report indicates the "programmed teaching" (PT) system is more efficient than textbooks at the first three grades — this appears true even with low enrollments down to 10 students. Keeping student costs low, but guaranteeing appropriate classroom activity, appears a reasonable strategy for the early grades.

5. The construction of the IEL materials specifically relied on the Revised National Curriculum as a basis of its content and design, and IEL appears to match the national curriculum requirements more faithfully than do the textbooks for the first three grades. IEL materials were specifically developed for Liberia, so the match is not surprising.

Textbooks may still be appropriate as enrichment materials in some areas (such as English or reading) or as focal materials in others (such as social studies). The point is that the IEL PT modules are the best available Liberian TEXT material.

6. Textbooks are the traditional medium of instruction only in the theoretical sense — few textbooks have ever appeared in most of the Liberian schools. Furthermore, there is no existing evidence that the current textbook selections would have their intended impact even if they were available (although it is taken as given that considerable improvement could be made through their use). The IEL materials for the early grades have been thoroughly field tested, revised, and formally evaluated; they have shown that they can provide what they promise.

BACKGROUND OF PROJECT COMPETITION

IEL and the World Bank Education Projects have been simultaneously, but independently, implemented. There have been gestures of cooperation and coordination, but no particular action has been taken which would indicate that any amalgamation will occur of its own accord. IEL remains isolated from the MOE, and the WB-4 has gone ahead with million-dollar textbook orders which effectively further alienate IEL. A serious attempt was made in January, 1984 ("Reflections on the Fifth Education Project: Comments on IEL vs Textbook Strategies") to initiate some purposeful collaboration between these projects, more specifically between the MOE, USAID, and the World Bank project team. It is clear that the technical issues surrounding

the combined use of these approaches can be solved in many ways once some direction is clarified by policy decisions. Communications on this clarification seem muddled — World Bank complains USAID will not engage in serious discussion, USAID claims the opposite is true, and the MOE "feels" very much like it is caught between two titans, both of which it would like to accommodate. The MOE strategy (unofficially) appears to be to wait-and-see: it cannot reasonably be expected (in its view) to wholly adopt an innovation, such as IEL, as its sole program, even after some trial successes, and it does not want to reject it either, especially since many parts of IEL would be useful even if the total package could not be assimilated (although this is undoubtedly a different perspective than USAID's). If the issue had been attended to a long time ago, the technical solutions could have been easily implemented. Now, some solutions entail considerable work and may be more complicated than would have originally been the case. Because of the sizeable investments (financial and psychological) in these approaches, the amalgamation has become politicized. The first evidence of this is "scapegoating", some of which has already begun. This paper is intended to refocus the discussion on SOLUTIONS, in the form of ACCOMMODATIONS, rather than personalities or histories. Meaningful collaboration MUST occur or the wastage will be tragic.

This situation was perhaps inevitable, or at least likely, because of certain management features of the development scene. On a project basis, both IEL and WB-4 can claim their own successes. If both had not been successful, then there would have been a "winner" and no choice or

accommodation necessary. It is tacitly agreed that both approaches can help the Liberian scene, so their mutual accommodation is important to future development. IEL was originally an experimental innovation, and it was never seriously envisaged by MOE that it would become the sole system (even if the argument could be made that it should be). Since the projects were administered out of different divisions in the MOE and the IEL Project was seen to have limited scope, there was no effort at coordination (and the Steering Committee approach is rarely effective at this anyway). The point is that changes in management must accompany any solution so that further initiatives will not be fragmented and non-directional.

A long-standing image of ministerial governance is one of concentrated Platonic power and responsibility. However, a second image is truer of the governance of Liberian educational programs and policy formation — pluralist accommodation. That is, in order to institutionalize innovations, attention must be paid to the context of accommodation, as well as the context of command. At any given time, some elements of educational affairs are under the authority of an official or body that has full command, but most times, influence in structuring and governing educational affairs is scattered among the various ranks of the sector. Most action is determined by pluralistic interest groups, not by a lone decision maker. Parties having divergent values, perceptions, and aims bear down on administrators to accommodate their view. The "decision", if any occurs, is a politically acceptable accommodation which emerges from these pressures. By virtue of its experimental orientation, the IEL project has paid little attention to the politics of institutionalization

— perhaps it shouldn't have until technical adequacy had been demonstrated. Now, accommodation of ideas and activities is required; this will require skillful management. The educational community is "traditional", potentially "volatile" (in verbal actions), and "fragmented". Management must serve in the context of accommodation and not dream idly of a Platonic guardian (phrase borrowed from Lee J. Cronbach) who can move independently on project planning and implementation.

APPROACHING ACCOMMODATION

Idealized project papers, superficial negotiations, scapegoating, and slick technology will not solve the institutionalization problems of IEL or the Ministry of Education. More attention must be given to the intended outcomes of these projects and the kinds of accomodations that will better or more likely lead to those outcomes. IEL has the advantage of success in the field; it has already established a satisfied constituency. Now, in the opinion of this paper, focus must shift to the supervision of its wider implementation and the management of accommodations needed to lead to a better fit in the larger system with associated institutional permanence. The only part of WB-4 which seemingly competes with IEL is the textbook scheme. Technical accommodations will be required, but the long term offers no necessary impediments to the useful merger of these approaches. The problems are mostly political and managerial.

The solution suggested here is that the MOE announce its intention to utilize both approaches, then, negotiate the MECHANISM and STEPS by which the necessary accommodations can evolve; this could constitute the essence of the managerial proposals for the project paper. The scenario offered in

the beginning of this paper can then serve as a first proposal for technical consideration. However, some clarifications are required in order to meaningfully proceed. Although it is fruitless to rigidly specify the conditions and terms for accommodation, a first step is to identify the intentions and expectations of relevant polities, notably USAID and the MOE. A partial list of statements that address some of the major premises on which an accommodation can be designed is found in Exhibit 2. These statements must be addressed in an on-going, meaningful way by representatives of the major entities to the accommodation. Such representatives must be empowered to act and provide the basis for operational activities. Too often have groups been constituted to solve problems only to be negated by required review and further study by another level of bureaucracy.

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EXHIBIT 2

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1. As a whole, the Liberian education system has a low quality instructional program, marked by unskilled teachers and few instructional materials. Either IEL or textbook-based approaches have a great deal to offer the educational system.

2. Although IEL and WB-4 have been implemented independently, integration of these approaches is desirable, both administratively and operationally.

3. IEL was an experimental program; however, its form and approach has evolved within the Liberian educational system, across a wide range of geographical locations. Although its origin was conceived along the IMPACT-type strategies, it is now unique in form and approach. IEL is distinctly Liberian.

4. The IEL experiment was a "success" as an innovative program. It resulted in low-cost materials, cuturally appropriate content, and an effective instructional system (as independently evaluated).

5. Textbooks are thought to be the "core" of the "traditional" Liberian educational system (even though few textbooks have been available in most schools). To be widely accepted IEL must accommodate to this conception of education (which of course implies that textbook-based instruction must also accommodate IEL).

6. Under WB-4, the MOE has already purchased numerous textbooks for grades 1-6; these are currently available to students across the country, in both

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the public and private schools. These books are likely to be on the market for 3 to 5 years. Any new policy must take into account this sizeable investment.

7. In order to provide students with the basic skills for continuing education (either within or outside of the formal system), the early grades of education are extremely important. Given the limited skills of the teaching cadre, better quality instruction is likely to result from greater structure of classroom activities at these formative grade levels. IEL provides greater structure than the use of textbooks.

8. Textbooks are "programmed" material, but their use is governed by teacher-initiated activities. Inspection of the schools across Liberia reveals that few teachers organize their instructional programs. If teachers do not use textbooks effectively, then IEL may have wider application than merely remediation.

9. IEL is very highly structured. In the "Programmed Teaching" (grades 1-3 approximately) phase of the system, virtually every action of the teacher is specified. The extent of this structure is thought by many in the MOE to be an impediment to widespread adoption, particularly in those schools which have "certified" teachers. In response to the original Project Paper for IEL-I (committee chaired by Gongar and included Agbenyega, Harding, and Seyon), the suggestion was made that structure should be limited and called "Learning Activity Packages" rather than "programmed". In developing the

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IEL system, the limited skills found in the schools suggested that more structure was required rather than less. Now, some accommodation must be made to change IEL from an experimental approach to one which will be seen to be relevant to the entire educational system.

10. IEL is an integrated system of instruction. In any unbundling of the package, care must be taken to retain the successful features of the package. For example, in reducing the "feel" of structure, the modules should be left intact and the schedule altered to allow more flexibility.

11. WB-4 textbooks were selected by curriculum panels in the subject areas. The intent was to pick the textbooks which were "close" to the national curriculum syllabus. In reality, the panels had to select the textbooks from the publishers who submitted bids, so they picked the "best" from the limited range of possibilities. These textbooks vary in the degree to which they match the syllabus. This will make integration with IEL less straightforward, because IEL follows the syllabus as closely as possible. More complete information about the textbooks is required. An additional point to be made is that the national curriculum (revised in 1980) may still be less than adequate. Should the curriculum be revised (implying a possible change to both IEL and textbooks), IEL revised to fit selected texts, or textbooks linked with IEL where possible (the remainder used as supplementary materials to IEL work)?

12. The WB-4 textbooks are not selling at the expected rates and therefore, they have not penetrated much of the educational system. Despite their lower cost than previous texts, the present economic situation may preclude any additional family expenses, even for school. Although cost is an important consideration throughout the system, the most important levels may be grades 1 - 3. IEL is the more cost efficient approach, so it should play a particularly important role in the earlier grades.

13. Textbooks are the core instructional materials for junior and senior high school, so the upper levels of the elementary system (grades 4 - 6) should provide experience in textbook use for the students. There is no particular evidence that an IEL approach would disadvantage any student in the transition. But, the apparent relevancy of textbooks will be important particularly in policies related to these latter grades and in the early phases of the institutionalization of IEL. Later improvements in the system can renegotiate the role of "programming" in Liberian education.

14. Few educators would advocate an educational system which used any one particular approach to learning. Although Liberian education is struggling amidst many problems, the educators are not likely to adopt innovations any more readily than their international colleagues. It is doubtful the IEL would be accepted as the sole instructional system in Liberia; to contribute to Liberian education, IEL must be integrated in some meaningful way. "National" or "nothing" rhetoric will almost certainly lead to "nothing".

15. Since IEL-I was an experiment, its conclusion, although successful in many ways, may be just a successful experiment. This, however, would consititute a huge loss to Liberia, who has co-contributed to this "experiment". Considerable effort in the IEL project was devoted to dealing directly with problems in this specific educational system. Not attempting to accommodate IEL will constitute a huge loss to Liberia.

16. Despite the improved availability of textbooks in the country, few textbooks have found their way into the classrooms. WB-4 addresses immediate needs in the Liberian educational system. Covenants associated with the IEL-II negotiations should not interfere with the attempts to get materials into the schools — now. IEL cannot be distributed nationally at this time and the needs are immediate.

17. IEL-II should be aimed at the institutionalization of the IEL approach, which is taken to mean the IEL and textbooks must be integrated in the instructional system in a meaningful way. IEL-II should focus on administrative and technical integration, orderly expansion (which entails printing and distribution costs), and improvement of management and supervisory skills.

18. IEL is presently aimed at the public school system. If Liberia is to avoid dual systems, the private schools must also be given the opportunity to participate in some way in the future IEL. Private schools constitute a sizeable proportion of the schools in Liberia and they are "seen" to be the

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"best" schools. Their access to these structured instructional materials would further institutionalize IEL.

19. Teacher training will be important to the future of Liberian education. IEL has focused on in-service training for teachers, mostly those who are uncertified for teaching; WB-4 has also focused on upgrading the uncertified teachers in the elementary system. Integration seems appropriate, but it is likely to be non-directional and fragmented unless the system used in the schools is also integrated. Attention must also be given to pre-service teacher training; the present program is not very successful, not even in the eyes of the teacher trainers themselves.

20. There is no reason to believe that any educational system will survive in practice once it is dependent on MOE recurrent funds. WB-4 has responded to this by setting up a revolving fund which is replenished with book sale income; if this works, it will be only a modest success. IEL has responded to this by providing all materials and making their production for future needs inexpensive. In considering the integration of IEL with textbooks, attention should be given to this problem. The debate so far has concentrated on the short-term.

21. Donors want their investments to be visible. In its extreme, this prevents institutionalization, so the parameters of justifiable credit to go to the WB and USAID need to be worked out. This is one of the "hidden agenda" items which require consideration.

22. The MOE is primarily concerned with its supervision system. The WB-4 is training many Liberians in supervision; a great deal remains to be done. No approach will be adequately implemented without an active supervisory scheme. An IEL-II which does not attend to this problem may not be supported (or supportable) by the MOE.

23. IEL remains "outside" the MOE; WB-4 lies within the MOE, but under the Department of Planning and Development. IEL and part of WB-4 are curriculum strategies, but they both lie "outside" the National Curriculum Development Center. Neither project has seen it as expedient to deal within the extant mechanisms for curriculum reform (although the NCDC has played a role in both projects). The textbook part of WB-4 is seen as supportive of the traditional system; institutionalization is not considered important because the mechanisms exist (although there is no project link with NCDC). IEL, however, is "different" and not only competes with WB-4 in educational strategy, but also may compete with NCDC if institutionalization is attempted outside of the MOE structure or the project is merely moved physically within the MOE without attention to mutual areas of responsibility.

24. The beginnings of a technical accommodation are outlined in the following statements:

a. Both approaches will be used in the elementary system, but emphases would be given to IEL in grades 1 to 3 and to textbooks in grades 4 to 6.

b. IEL modules should be kept intact, but the schedule format should

EXHIBIT 2 (Continued)

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be loosened to allow for the use of textbooks and other teacher initiated activities.

c. Textbooks are an immediate need of the schools and will remain the dominant system until IEL has expanded its base of acceptability and integrated with textbooks.

d. No part of the IEL system will be scrapped necessarily in the integration effort, but it may require adjustments to be realistically accommodated in the system.

e. IEL teacher training should be jointly planned and implemented with the more traditional teacher in-service training currently going on.

Exhibit . Ministry of Education Central Office

Office	Staff Nos.
Office of the Minister	8
Office of the Internal Auditor	4
Legal Counsel Office	2
Division of Scholarship	10
Office of Deputy Minister for Administration	7
Office of Assistant Minister for Administration	6
Division of Building & Grounds	45
Janitorial Services Section	3
Transport Unit Section	36
Communication Unit Section	4
Central Filing Section	3
Dispatch Office	5
Book Store Agency	11
Division of Warehousing & Supply	17
Security Section	23
Printing & Production	13
Division of Finance	13
IBM Section	1
Administration Unit	1
Pay Office	1
Personnel Division	13
Office of Deputy Minister for Instruction	8
Office of Assistant Minister for General Supervision	11
Division of Kindergarten Education Supervision	2
Division of Adult Education	9
Religious/Special Education	3
Community School Program	4
Improved Efficiency of Learning	25
Office of Assistant Minister for Professional/Technical Education	1
Vocational/Technical Supervision Division	12
Science Education Supervision Division	3
Division of Home Economics	14
Division of Teacher Education	4
Division of Radio Media Education	6

(Continued)

Exhibit . Ministry of Education Central Office

Office	Staff Nos.
National School of Music	1
School Feeding & Agricultural Project Unit	10
Office of Assistant Minister for Curriculum	3
Division of Student Personnel Services	11
Division of Curriculum Development	17
Office of Deputy Minister for Planning & Development	13
Office of Assistant Minister for Planning & Development	6
National Secretariat Section (UNESCO)	5
Division of Research and Publications	6
Division of Statistics	9
Division of Education Planning	10
Project Implementation Unit	17
Division of Educational Facilities	20
Textbook Unit	8
Division of Information Systems & Data Services	10

Source: Division of Information Systems and Data Services

WB

Exhibit . Educational Subsector Foci of World Bank Project Investments*
(in 1972 Real US$ thousands)

Subsector Focus	WB1		WB2		WB3		WB4		TOTAL	
	$	%	$	%	$	%	$	%	$	%
Primary	225.0	2.9	1,308.8	39.1	—	—	3,117.0	29.5	4,650.8	17.3
Secondary	3,575.0	46.9	—	—	1,767.2	33.5	—	—	5,342.2	19.9
Tertiary	2,536.0	33.2	530.5	15.8	225.6	4.3	1,163.9	11.0	4,456.0	16.6
Vocational/ Technical	235.0	3.1	323.4	9.7	2,839.7	53.8	2,064.4	19.5	5,462.5	20.4
Educational Administration	1,058.0	13.9	1,186.3	35.4	447.0	8.5	4,228.8	40.0	6,920.1	25.8
Total	7,629.0	100.0	3,349.0	100.0	5,279.5	100.0	10,574.1	100.0	26,831.6	100.0

* Primary includes Community Schools and Primary Schools only
Secondary includes STCs and Multilateral High Schools only
Tertiary includes University of Liberia (COAF, TTC, UPU), KRTTI, and ZRTTI
Voc/Tech includes FTI, LSVTC, Tubman High, MVTC, AITB, CBDTC, and Adult Education
Ed/Admin includes All MOE Units and Divisions and LIPA, MPEA, WAEC

WB

Appendix B. Ministry of Education Textbook Policy Notice (New Liberian, February 8, 1985)

Ministry Of Education
Monrovia, Liberia
ANNOUNCEMENT

It has been brought to the attention of the Ministry of Education that some schools are not using the prescribed textbooks of the Ministry as the main texts. Instead they use other books for their main texts and the ministry prescribed ones as supplementary.

The ministry will not condone schools using other texts as their main texts and the prescribed texts by the ministry as supplementary.

These prescribed books are currently available at the ministry's bookstore, Broad Street, Monrovia. Any school found not using the prescribed textbooks as its main text will be penalized accordingly.

Signed: _____

Raymond B. Jallah
DEPUTY MINISTER FOR INSTRUCTION

Approved: _____
G. E. Saigbe Boley
M I N I S T E R

WB

Exhibit A. Development Foci of World Bank Project Investments
(in 1972 Real US$ thousands)

Development Focus	WB1		WB2		WB3		WB4		TOTAL	
	$	%	$	%	$	%	$	%	$	%
Facilities Development	5,599.4	73.4	2,136.9	63.8	3,976.5	75.3	4,774.5	45.2	16,487.3	61.4
Program Development	1,994.6	26.1	903.7	27.0	769.7	14.6	3,925.6	37.1	7,593.6	28.3
Staff Development	35.0	.5	308.3	9.2	533.4	10.1	1,874.0	17.7	2,750.7	10.3
Total	7,629.0	100.0	3,348.9	100.0	5,279.6	100.0	10,574.1	100.0	26,831.6	100.0

WB

Exhibit C. Development Foci of ADB Project Investments
(in 1972 Real US$ thousands)

Development Focus	ADB1		ADB2		TOTAL	
	$	%	$	%	$	%
Facilities Development	2,878.2	87.8	4,181.5	94.3	7,059.7	91.5
Program Development	83.1	2.5	80.6	1.8	163.7	2.1
Staff Development	317.4	9.7	172.0	3.9	489.4	6.4
Total	3,278.7	100.0	4,434.1	100.0	7,712.8	100.0

WB

Exhibit D. Educational Subsector Foci of ADB Project Investments
(in 1972 Real US$ thousands)

Subsector Focus	ADB1		ADB2		TOTAL	
	$	%	$	%	$	%
Primary	2,878.0	87.8	3,375.0	76.1	6,253.2	81.1
Secondary	—	—	—	—	—	—
Tertiary	317.4	9.7			317.4	4.1
Vocational/ Technical	—	—	—	—	—	—
Educational Administration	83.1	2.5	1,059.1	23.9	1,142.2	14.8
Total	3,278.7	100.0	4,434.1	100.0	7,712.8	100.0

WB

Appendix A. Implicit Price Deflators for GNP (in 1972 US$)

Year	Deflator
1972	100.0
1973	105.95
1974	115.08
1975	125.79
1976	132.34
1977	140.05
1978	150.42
1979	163.42
1980	178.42
1981	183.00
1982	186.01

Sources: Department of Commerce, 1976, p. 5
Department of Commerce, 1983, p. 293

II

Cost Issues in the Liberian Improved Efficiency of Learning (IEL) Project

Report No. 1 of the IEL Cost Analysis Project

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January 1983

COST ISSUES IN THE LIBERIAN
"IMPROVED EFFICIENCY OF LEARNING" (IEL) PROJECT
Report No. 1

INTRODUCTION

Between November, 1981 and April, 1982 the IEL project underwent three separate reviews by external examiners. Dr. Robert Jacobs of Southern Illinois University produced a report entitled "Formative Evaluation of the Improved Efficiency of Learning Project." This was followed by "An Evaluation of the Improved Efficiency of Learning Project," prepared by Dr. Grant Harrison of Brigham Young University and Dr. Robert Morgan of Florida State University. These two reports concentrated upon the issues of materials development and project implementation within the IEL schools and, although there is a significant difference in the tone of the two reports, both were supportive of the goals of IEL and the current strategies for their achievement.

A third report, "Improved Efficiency of Learning Project: Mid-Term Evaluation Committee Report," was prepared by a panel consisting of Liberian government, USAID/Washington, and USAID/Liberia personnel. This report was again supportive of IEL (including the proposed extension of time and funds for the project). In addition to reviewing the materials and implementation activities, the Evaluation Committee concentrated upon the overall management of the project and future needs for consultation and evaluation. The committee noted that the "project now requires a more thorough and analytic study of both development and recurrent costs" and recommended that "a thorough cost study be conducted as soon as possible."

A decision was made to commission the present cost analysis project in response to this recommendation. The project is to have five major outcomes:

(1) The specification of a cost methodology to allow for comparison of IEL costs both in their present context and as they will be incurred during any planned implementation into additional schools;

(2) The collection, review, and analysis of existing reports and cost data on IEL and non-IEL instructional and administrative costs;

(3) The identification and elaboration of internal and external efficiencies as they exist in the present IEL system and as they would exist under implementation;

(4) The quantification of the cost-effectiveness of IEL instruction relative to that of two alternative models of the traditional Liberian primary school system; and

(5) The provision of estimates of the cost effects of alternative modes of IEL dissemination and implementation within the primary school system.

This initial report of the cost analysis deals with the first two of these outcomes. The present activity is not responsible for an analysis of past, present, or future IEL project costs except as they relate to the above outcomes.

The main product of this first report is to itemize the estimated costs for IEL and non-IEL schools in five main areas: teachers' salaries, materials costs, facilities and equipment costs, administrative and supervisory costs, and teacher training costs.

Because of the issue of textbook availability, alternative cost estimates of non-IEL schools will be made inclusive and exclusive of textbook costs. (Estimates have been made that as few as three percent of all primary school students possess textbooks.) The remaining three parts of the cost-analysis project will involve:

(1) The opportunities for, and the cost effects of, potential internal improvements in efficiency and external economies of scale within the IEL system;

(2) An initial and provisional cost-effectiveness comparison of IEL and non-IEL schools based on the summative evaluation work conducted by Dr. Klaus Galda; and

(3) An analysis of the cost impacts of alternative dissemination strategies.

As to this last activity, planning the actual design for implementation of dissemination will be the responsibility of Ministry of Education and IEL staff. The role of the cost-analysis project in this effort will be to provide estimates of the cost implications for the major alternative strategies to be identified. For example, both training and production/distribution costs are affected by the number of schools, their location, the existing quantity and quality of their teaching staff, equipment and facilities, the phasing of dissemination by grade level, and related characteristics.

The remainder of this report will discuss the framework for the cost determination and analysis as well as present the initial findings on the costs of IEL versus non-IEL schools in terms of types and level. Before proceeding to the estimates themselves, it is important to explain the economic concept of cost analysis which is used in the evaluation of alternative classroom methodologies.

THE ECONOMICS OF COST ANALYSIS

Two major types of economic analysis are appropriate for the present stage of IEL project activity. First, there is a need to compare the potential cost-effectiveness of the IEL experimental system to the conventional Liberian classroom methodology (consisting of teacher lectures with or without support from textbooks and related instructional materials). Second, the cost effects of a potential dissemination of IEL to the conventional Liberian schools is an important issue should the cost effectiveness results and other considerations of Liberian educational policy justify such action. In this section, the rationale

for use of a comparative cost analysis in both the cost-effectiveness and dissemination studies will be presented.

The choice faced by the researcher/planner in all cost analysis is between an analysis of total costs versus relative costs. In a total cost format, it is necessary to conduct a study of the full unit costs (per school or per student) for the following major components: facilities, equipment, materials, instructional and supervisory personnel, and requisite training. These costs would be estimated for both the experimental instructional system and for the traditional system. Such detail is necessary, however, only if school equalization rather than adaptation is the policy goal. Since the envisaged IEL project dissemination does not require that every school be made to approach some identical design in terms of all of the major resource components, it is possible to use the comparative cost format of analysis.

This is fortuitous since the Liberian primary educational system remains quite heterogenous especially in terms of available facilities and instructional quality. Also, there are serious methodological limitations in the unit cost estimation (e.g., calculation of the interest and depreciation values of facilities such as elementary schools, for which there are often no local alternative uses, is especially problematical).

The marginal or comparative cost format of analysis emphasizes the determination of the change in costs for a conventional Liberian school required to adapt to the IEL technology. These costs may be estimated in terms of the initial budget costs of dissemination (an important consideration for Ministry of Education budget planning) and in terms of the effect of the new program on recurrent costs (an important consideration given the present restrictions on the absorptive capacity of the Liberian National Budget). The first of these estimates will be emphasized in the subsequent report on cost-analysis issues for dissemination of IEL and the second will be a major issue for the report on the initial cost-effectiveness evaluation of IEL.

The first requirement for the marginal cost analysis has been to study the IEL programmed teaching (PT) and programmed learning (PL) systems to determine the requirements they will make on school resources. It is important to note at the outset that the IEL system as it exists in the laboratory school setting is not necessarily the appropriate model for estimating the instructional system's structure under the eventual dissemination plan. The daily teacher support and instruction provided by the IEL Instructional Supervisors, while necessary during the experimental stage of materials development and testing, would represent a prohibitive cost condition for immediate dissemination. It is planned that the new IEL experimental schools will operate with a level of supervision which approximates a more realistic assumption of available supervisory resources.

One of the advantages of the marginal cost approach is that it can be adapted to a variety of dissemination designs. If it should be decided that the dissemination plan will include less than full utilization of any part of the experimental IEL design, this change can be incorporated directly into the cost analysis. Similarly, for dissemination cost planning, any combination of phased grade-level or locational (by size of place, county, or other geographical determinant) dissemination plan can be costed directly from the effect of the particular design on existing school requirements.

The major cost components for Liberian primary education are the following:

(1) Teacher salaries;
(2) Materials costs;
(3) Facilities and equipment costs;
(4) Administrative and supervisory costs; and
(5) Teacher training costs.

Teacher Salaries: An important benefit claimed for IEL in its original planning documents was that the modularized curriculum approach and related instructional technology would compensate for the inadequacy

of preparation of most primary school teachers. Teachers with less than a high school education are classified in Liberia as "unqualified" and those with a high school education or more, but without formal teacher training, are classified as "underqualified." To the extent that the IEL system allows for the successful use of these teachers, it will have no effect on the salary requirements of dissemination schools.

However, it is important to remember that, because the IEL system requires much more effort and time-on-task than is the expectation (or at least the realized performance) of teachers in other primary schools, the IEL teachers have expressed dissatisfaction with their pay. In dissemination it will be important to test the proposition that new IEL teachers will be willing (or to discover what proportion will be willing) to adapt to the increased work demands of the IEL system without the receipt of additional salary payments. If they are not willing to do so, it may be necessary to require salary supplements or increases. This will become a factor in both the cost-effectiveness and the dissemination costs analysis.

A point underemphasized in much of the earlier project analysis is that an effect of the IEL approach will be not only to compensate for the inadequacy of unqualified or underqualified teachers, but also to complement the skills of Liberia's cadre of truly qualified teachers (who should not be assumed to be identical to those who are certified as "qualified"). The IEL modularized curriculum is designed to work with minimally qualified teachers, but it should work even better where teachers can combine administrative and pedagogical skills to employ the curriculum materials fully. If this supposition is correct, the increased efficiency of qualified teachers is a potential cost-offset within the evaluation of IEL dissemination costs.

Materials Costs: The single most dramatic effect of IEL instruction is the change in the amount and type of instructional materials used in the classroom. For the programmed teaching in Grades One and Two, and the first semester of Grade Three, five main types of

educational materials will be used: PT modules, reading booklets, review booklets, practice booklets, and semester tests. For the programmed learning system used in the second semester of Grade Three and in Grades Four to Six, the IEL materials consist of PL modules, student guides, module test booklets, module test answer keys, block and semester test booklets, and an arts and crafts manual.

While these materials theoretically may be viewed as replacing the use of textbooks, the fact is that, as was stated earlier, very few Liberian primary school students are estimated to have access to textbooks at the present time. The new Liberian-World Bank educational loan includes funds for acquisition and distribution of "economical" textbooks. The issue for the current cost analysis is to establish a base-line cost against which the IEL materials can be contrasted. The approach to be used is to parallel the summative evaluation design in which status quo (SQ) schools are defined as those with no textbooks (and unqualified or underqualified teachers) and optimal control (OC) schools are defined as those in which both qualified teachers and textbooks exist. Thus, a two-level cost comparison will exist between the IEL and SQ schools and the IEL and OC schools. Obviously, there will be an increase in costs from conversion of the SQ schools to the IEL system, but the relative costliness of IEL to OC schools will depend on the costs of IEL materials versus those of the required textbooks. Although final estimates will likely be unavailable by the time the cost-analysis project concludes in June, 1983, it will be important to consider IEL costs versus both current and projected textbook expenses (based on the World Bank reduced textbook cost activity).

Currently, however, most primary schools are closer to the SQ than to the OC end of the spectrum of resource availability. Thus, the policy issue for Liberia is two-fold: whether to increase the use of instructional materials in primary school classrooms and, if they are to be increased, whether the IEL or the low-cost textbook alternative is the most cost-effective. An important consideration in this regard is whether the technology for the production of low-cost textbooks can

be adapted to an even less expensive production of IEL materials than is projected from the present production methods.

Facilities and Equipment Costs: The IEL instructional system has been designed to operate with a minimal requirement for facilities modification or for additional equipment. The present IEL format requires only a lockable room at the school. (This would normally be for the principal's office where IEL materials would be stored when not in use.) The required equipment is for a 4' by 8' classroom blackboard; one group blackboard 2' by 4' for each 3-to-7 students in PT and one for each 4-to-7 students in PL; one lap board 9½" by 12" by 36". This box is designed to include all IEL materials required for a single semester of PT for 60 students or of PL for 70 students. The storage box and its IEL contents are collectively entitled a "semester package."

These equipment requirements will represent an increase in resources for most classrooms. While it is not unusual for schools to have some form of rudimentary blackboards, the requirements for group blackboards and individual lap boards will represent a marginal increase in costs from adoption of the IEL system. Similarly, the storage box is a new piece of equipment for primary schools.

Administrative and Supervisory Costs: An issue which remains to be resolved during the experimental stage of IEL is that of the requirement for administrative and supervisory assistance. These requirements exist at three levels: the classroom, the school, and the school system. At the classroom level, teachers will require some supervision and assistance if they are to implement the IEL instructional program properly. The IEL system is sufficiently complicated, and more importantly, sufficiently different from the traditional instructional system that the role of teacher supervision and assistance may prove crucial. Such activities would be required most intensively in the initial stages of implementation and could later be reduced or phased out depending upon the rate at which teachers adapt successfully to the

new system. The policy question ultimately will be how much supervision is required, if any, and who should provide it? As to the latter, the school principal is one alternative while the Ministry of Education district or regional personnel represent another.

At the school level, an initial constraint on the use of principals as instructional supervisors for teachers will be that the principals, being new to IEL, may themselves require supervision initially to see that the administrative and monitoring tasks required of them under IEL are handled properly. Supervision and assistance to principals should represent shorter and less time-extensive activities of the IEL dissemination system.

Finally, at the system level, there will be a need to supervise the system of materials distribution, teacher training, and related activities which will be an ongoing responsibility of the Ministry of Education as any projected IEL dissemination plan materializes. Both the construction of the dissemination system and its administrative/supervisory design will be a joint responsibility of the IEL project and the Ministry of Education.

For costs purposes, the issue of administration and supervision requirements is complex. If the supervisory personnel of the Ministry of Education were already performing in a highly effective manner (reflecting adequate training for their responsibilities and the availability of resources sufficient to fulfill their responsibilities), then there would be very little marginal cost related to conversion of schools to the IEL system. However, the present status is that both training and resource availability have been insufficient to allow for the full potential of the Liberian system of educational supervision to be realized. In fact, one of the anticipated supplementary benefits of IEL expansion is that it might provide a structure within which the supervisory system will itself be made more cost-effective.

For present purposes, the following compromise is proposed. For the cost-effective analysis, estimates will be made for IEL both

inclusive and exclusive of increased supervisory costs. For dissemination planning purposes, the cost requirements for supervision will be explicitly considered at each of the three levels of system, school, and classroom.

Teacher Training Costs: The implementation plan presently considered would require a three-to-four-week period of intensive teacher and principal training prior to the introduction to the concepts of programmed teaching, programmed instruction, and the use and administration of modularized curriculum materials. The major cost components of any teacher training program are: instructional fees, materials costs, room and board expenses for trainees, and transportation charges.

Currently, two teacher training exercises are being conducted related to the IEL project. The IEL Implementation Staff will offer a Training Workshop in February, 1983 for all principals and teachers of Grades One through Six from the eleven experimental IEL schools and the five IEL system schools. Because the current plan calls for teachers in IEL schools to share responsibilities for both PT and PL instruction, the training program will provide exposure to both systems for every teacher trainee.

A second teacher training activity is planned for the principals and teachers of the OC schools. The rationale for this is the desire to structure the eventual comparison between IEL and OC schools so that the OC schools represent the "best case" of what can be expected from rural schools under the conventional curriculum methodology. The OC teacher training will emphasize content and pedagogy based on the current Ministry of Education curriculum.

Again, the definition of expenses which should be assigned to IEL is problematical. The IEL teacher training expense obviously represents a cost addition compared to the alternative of no change in the present Liberian system. If one structures the comparison as being between IEL with teacher training and OC with teacher training the issue is reduced

to which teacher training format is more expensive (with the major residual differential being the relative effectiveness of the two systems as measured by student performance). For the present, the procedure used shall be to indicate the level of required teacher training costs for each of the three types of schools within the summative evaluation: IEL, SQ, and OC. The final decision as to the proper structure for comparison of the three school types will have to be made by the Ministry of Education based upon their teacher training plans, with or without the wide-scale implementation of IEL.

The IEL cost-effectiveness analysis, to be discussed in Report No. 3 of the cost-analysis project, will include teacher training costs only for IEL schools because 1983 is the first year in which the OC schools will receive in-service teacher training. However, it will be stressed within the cost-effectiveness report that if IEL can be shown to be equally or more effective, while requiring less total pre- and in-service teacher training, then this by itself represents a significant cost offset in favor of the IEL program.

In this section an attempt has been made to explain the rationale for use of a marginal cost approach to the analysis of the IEL program. In addition, the major cost components of the program have been discussed in terms of the structure of the proposed comparisons to be made. In the subsequent section attention will turn to the derivation of actual cost estimates for each of the IEL cost components.

COST ESTIMATES FOR IEL

In this section an attempt will be made, based upon the current design and plans for IEL, to derive cost estimates for implementing the IEL curriculum methodology in non-IEL schools. Because IEL remains in a developmental stage, these cost estimates, while they will represent the best available data, are preliminary estimates only. This is

especially true for concerns such as supervisory costs and teacher training costs where final design issues remain to be resolved. Nevertheless, these estimates can serve two useful purposes.

First, these estimates can be combined with the initial estimates of effectiveness to give a preliminary understanding of how well the IEL system compares with conventional primary schools. As noted elsewhere, both the cost and effectiveness measures are provisional (and neither will be derived without certain assumptions concerning definition and measurement) and should not be expected to measure project "success" or "failure." Rather, the estimates serve as an advance indicator of what the final summative results might be and will help clarify some of the debate over the proper structure of the final summative evaluation.

The second and possibly more important benefit of the cost-analysis exercise is to alert the IEL staff to areas of the IEL project where significant cost problems may occur in the implementation stage. This information will allow for reconsideration of these aspects of the IEL system to assure that internal efficiencies have been maximized and will allow for modification of implementation plans, if and when necessary, to adapt to these cost considerations.

Each of the cost components discussed earlier will be reviewed in turn. Because of the centrality of the materials component of IEL, the greatest emphasis will be on that topic. This section will conclude with a summary of the cost estimates and the inferences which may be drawn from them.

TEACHER SALARIES

The base salary for all primary teachers (regardless of qualifications) is $260 per month. Because of the recent announcement of an austerity reduction of 16½ percent in all government employees' salaries, primary school teachers will now be earning approximately $215 per month.

Although the IEL program is designed to allow for the use of less-qualified teachers, the fact that no pay differential exists by qualification level will mean that no immediate cost saving can be claimed for IEL. However, this would change if the Ministry of Education's "Handbook of Policies and Procedures for Certification of Educational Personnel" (March 1, 1982) were adopted as official government policy. In addition to establishing criteria for certification, this document proposes a revised salary schedule within which a Grade C teacher (high school graduate plus 18 hours of teacher training) would receive $300 per month. As the Grade C certificate holder is the most likely form of qualified primary school teacher, the difference between the $260 per month for an unqualified teacher and the $300 per month for a qualified primary school teacher represents a potential cost saving.

However, the ultimate goal of the Ministry of Education is to upgrade all teachers. This process is severely constrained by the financial and training resources of the country, the scale of the task, and the time by which such a program would have to be instituted. The IEL system allows potentially (if its achievement goals are realized) for the transition to a fully-qualified teaching corps to be accomplished in the long run without requiring a continued short-run sacrifice in student learning.

An additional economizing function of the IEL system is its ability to increase the optimum student-teacher ratio. If the results of the evaluation of the experimental phase of IEL development indicate that PT teachers can indeed work effectively with sixty students and PL teachers with seventy students, this will allow for significantly low teacher costs per student. For example, for a teacher receiving an annual salary of $260 (for an unqualified teacher) or $300 (for a qualified teacher), the monthly per-student costs for a teacher are as follows for different class sizes.

Class Size	Unqualified Teacher	Qualified Teacher
10	$26.00	$30.00
20	13.00	15.00
30	8.67	10.00
40	6.50	7.50
50	5.20	6.00
60	4.33	5.00
70	3.71	4.29

Within the primary schools as they exist today, these savings will not be realized because the introduction of the IEL system of instruction will not, by itself, lead to a change in student-teacher ratioc. Over time, however, adjustments can be made in per-student costs because the IEL system will not require the same rate of replacement for teachers lost through attrition and IEL will permit teacher reassignment for the staffing of new primary schools. Given the projections of a continuing increase in the primary school age cohort and of the probability of increasing primary school attendance, the capacity allowed by the IEL system for a higher student-teacher ratio (with the expectation of no sacrifice, and perhaps even a gain, in learning rates) is a major long-term benefit to be derived from wide-scale implementation.

MATERIALS COSTS

Table One represents a summary of the materials requirements for IEL introduction into a primary school. The numbers represent the contents of a "semester package." This package contains adequate supplies for up to 60 PT students and up to 70 PL students. Because of the shift from the PT to PL format in the middle of Grade Three, the first (I) and second (II) semester figures represent a change in both

TABLE ONE

MATERIALS REQUIREMENTS FOR IEL

(PER SEMESTER PACKAGE)

Item	Originals	Copies	Average No. of Pages	Total Pages
Programmed Teaching				
Grade One				
Modules	20	1	80	1,600
Review Booklets	4	15	74	4,440
Practice Booklets	14	5	20	1,400
Semester Test	1	1	5	5
Grade Two				
Modules	20	1	80	1,600
Reading Booklets	1	15	40	600
Review Booklets	4	15	74	4,440
Practice Booklets	14	5	20	1,400
Semester Test	1	1	5	5
Grade Three (I)				
Modules	20	1	80	1,600
Reading Booklets	1	15	80	1,200
Review Booklets	4	15	74	4,440
Practice Booklets	14	5	20	1,400
Semester Test	1	1	5	5
Programmed Learning				
Grade Three (III)				
Modules	50	7	24	8,400
Student Guides	1	10	2	20
Test Booklets	10	7	12	840
Test Answer Keys	1	1	48	48
Block & Semester Tests	1	1	78	78
Grades Four, Five and Six (per grade)				
Modules	60	7	24	10,080
Student Guides	1	10	2	20
Test Booklets	10	7	12	840
Test Answer Keys	1	1	48	48
Block & Semester Tests	1	1	78	78
Arts & Crafts Manual	1	1	100	100

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quantity and type of materials used. Grades Four, Five, and Six use the same number of modules, etc. each semester so the numbers for these grades are presented collectively.

The following presents a brief definition of each type of instructional material used in the IEL system:

(1) PT module - used solely by the teacher for instruction.

(2) PL module - used by students for peer group and home study.

(3) Reading booklets - cover all subjects; are used only during some PT direct instruction lessons.

(4) Practice booklets - used by small groups (3-to-7 students) following direct instruction.

(5) PT semester test booklet - used solely by the teacher; includes instructions and scoring key.

(6) Student guides - provides instruction for students in appropriate behaviors for studying in peer groups.

(7) Module test booklet - used daily to test students on content of previous day's module lesson.

(8) Module test answer keys - for use by the teacher.

(9) PL block and semester test booklet - similar to PT semester test booklet, but includes test for block periods (first two six-week periods in each semester).

(10) Arts and crafts manual - used by teacher as basis for direct instruction of students.

The term "originals" in Table One refers to the number of separate and individual items of each type. For example, in Grade One, there are twenty separate modules on different topics. The term "copies" refers to how many duplicates of each original are required for a semester package.

The number of copies varies depending upon the manner in which a particular type of material is used. PT modules are used only by the teacher and so only one copy of each is used. Review booklets are used by students in direct instruction groups (ideally not exceeding fifteen

students per group). Thus fifteen copies are required to assure each child an individual booklet.

Obviously, the most dramatic characteristic is the number of original documents required. These vary from thirty-nine per semester in Grade One to seventy-four per semester in Grades Four, Five, and Six. The total number of originals required for all grades is 705 and, taking into account the multiple copies required of certain items, the total materials set exceeds 4,000 individual pieces of instructional material. These numbers have two important implications. First, they point to the need for improved classroom administration; this point has been carefully studied by the IEL staff and has led to consolidation of materials and to the formulation of the semester package concept. Second, these numbers are indicative of one of the important limitations on the exploitation of major economies of scale in printing. Since it normally requires a press run of 10,000 to 20,000 copies to achieve substantial savings from the printing process, the large number of originals but relatively small quantities of copies required for IEL work counter to the normal economies of scale that exist for traditional instructional materials (such as textbooks, for example). This issue will be dealt with in more detail in Report No. 2.

Table One concludes with a calculation of the total number of pages required in a semester package for each item of instructional material. These amounts are summarized in Table Two, which presents an initial estimate of the cost of production of a semester package for each grade level, with a separate estimate for two semesters of Grade Three.

TABLE TWO

INITIAL MATERIALS COSTS FOR IEL DISSEMINATION

Grade Level	Total Pages in Semester Package	Number of Semesters	Subtotal	Cost per Page	Total
Grade One	7,445	2	14,890	$.03	$ 446.70
Grade Two	8,045	2	16,090	.03	482.70
Grade Three (I)	8,645	1	8,645	.03	259.35
Grade Three (II)	9,386	1	9,386	.03	281.58
Grades Four, Five, and Six	11,166	6	66,996	.03	2,009.88
Total	44,687		116,007		$3,480.21

Using the IEL estimate of $.03* per page as the total cost of paper, reproduction, and binding, the last column of Table Two presents the total cost of IEL materials for the grade levels as presented. The cost increases from $446.70 for a semester package for Grade One to $669.96 for each of Grades Four to Six. The total initial cost of providing a set of semester packages (one semester package per semester per grade) to an elementary school is $3,480.21.

Two major considerations must be introduced before this last figure can be compared meaningfully to the textbook alternative currently available in Liberia. The annual recurrent cost of IEL materials will depend upon the number of years a set of original materials may be used and on the number of students served by each set. Table Three presents two estimates for the annual costs of IEL materials based upon two sets of assumptions concerning the rate of replacement of IEL materials.

*The appropriate rate to be charged for IEL production will be analyzed in detail in Report No. 2.

TABLE THREE

ANNUAL COST OF IEL MATERIALS

Item	Total Pages	Original Cost	IEL Estimate Expected Life	IEL Estimate Annual Cost	Conservative Est. Expected Life	Conservative Est. Annual Cost
GRADE ONE						
Modules	3,200	$ 96.00	2	$ 48.00	2*	$ 52.80
Other Mat.	11,690	350.70	5	70.14	4	87.68
Total	14,890	446.70		118.14		140.48
GRADE TWO						
Modules	3,200	96.00	2	48.00	2*	52.80
Other Mat.	12,890	368.70	5	77.34	4	96.68
Total	16,090	482.70		125.34		149.24
GRADE THREE (I)						
Modules	1,600	48.00	2	24.00	2*	26.40
Other Mat.	7,045	211.35	5	42.27	4	52.84
Total	8,645	259.35		66.27		79.24
GRADE THREE (II)						
All Materials	9,386	281.58	5	56.32	4	70.40
GRADE FOUR						
All Materials	22,332	669.96	5	133.99	4	167.49
GRADE FIVE						
All Materials	22,332	669.96	5	133.99	4	167.49
GRADE SIX						
All	22,332	669.96	5	133.99	4	167.49
GRAND TOTAL	166,007	$3,480.21		$768.04		$942.07

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Based upon an examination of the frequency of use, the quality of materials*, and the probability of loss, the IEL project team has estimated a life of five years for all materials except PT modules, which are expected to need replacement every two years. Because of the nature of materials maintenance in rural schools and the initial familiarity of students and teachers with such materials, the five-year estimate may be unduly optimistic. This is especially the case for items such as PT review booklets which leave the classroom and are thus subject to less control and a higher incidence of loss.

To examine the significance of the assumption about material life, a more conservative set of figures is also used in Table Three to test the sensitivity of the dollar estimates to a variation in realized length of material use from that anticipated by the IEL staff. The replacement rate for PT modules has been increased by ten percent from the original assumed life of two years (the revised estimate is indicated in the table as "2*"). The assumed life of materials has been reduced from five to four years.

The annual cost estimates vary from $118.14 for Grade One to $133.99 for each of Grades Four to Six for the IEL assumptions and from $140.48 to $167.49 for the alternative assumptions. The total annual cost of using IEL materials in a primary school with one class at each grade would be $768.04 for the IEL estimate and $942.07 for the alternative estimate.

As noted earlier, the IEL system is designed to operate with a class size of sixty students for PT and seventy for PL. Because of the requirements for individual and group use, the semester packages represent the minimum level of materials for any class size up to these optimal sizes. While sizes slightly in excess of sixty for PT or seventy for PL can be accommodated, the rigidity of the material requirements leads to a "step-function" in terms of the average cost (cost per student) of IEL materials. This means that a two-semester package for Grade One purchased at the IEL annual cost figure of $118.14 would

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*All IEL materials are to be of 20-lb. paper with cardstock covers and are stapled.

decline in average cost up to the sixtieth student and would then suddenly increase again as a second full set is required. Table Four presents the average cost figures per grade level for different quantities of students in a hypothetical school.

The lowest average cost figures occur at multiples of sixty for PT and of seventy for PL classes. It is important to remember, therefore, that these amounts are the minimum, not the average or anticipated values of per-student costs. As schools increase in size with multiple classrooms of IEL instruction, the per-student cost will rise with the addition of each new semester package, but then begin to decline again until a new multiple of the optimum class size is reached.

In economic terminology, there are positive scale effects (reductions in average cost as number of students increases) for the use of a single semester package. There are negative scale effects for introduction of an additional semester package and then a re-establishment of positive scale effects until the multiple of the optimum size is reached once again. The relevance of this is in the consideration of the probable class size of the schools to which IEL will be disseminated. The reality of the Liberian primary school system is that there is a great variation in class size with enrollments in the upper primary grades often being well below the IEL optimum. This will be the case especially in the rural primary schools which are the focus of the IEL project. While it may be possible to take advantage of the positive scale effects at the first- or second-grade level, the rate of attrition is such that the smallest class sizes are always at the higher grades.

School consolidation is not an alternative except in the cities and larger towns, and even there the expense and availability of transportation often represents a prohibitive restraint on this alternative. Multi-grade teaching, while a means of lowering average teacher costs, has no effect on average materials cost. In fact, the conditions which force multi-level teaching in the present system (small numbers of students at each grade level) will represent the source of a significant cost-increasing effect for average material expense.

TABLE FOUR

PER STUDENT COSTS OF IEL MATERIALS

by Grade and by Class Size

Grade Level	Annual Cost*	Number of Students										
		20	40	60	70	80	100	120	140	160	180	200
GRADE ONE	$118.14	$5.91	$2.95	$1.97	$----	$2.95	$2.36	$1.97	$2.53	$2.22	$1.97	$----
GRADE TWO	125.34	6.27	3.13	2.09	----	3.13	2.51	2.09	2.69	2.35	2.09	----
GRADE THREE (I)	66.27	3.31	1.66	1.10	----	1.67	1.33	1.10	1.42	1.24	1.10	----
GRADE THREE (II)	56.32	2.80	1.41	.94	.80	1.41	1.13	.94	.80	1.06	.94	.80
GRADE FOUR	133.99	6.70	3.35	2.23	1.91	3.35	2.68	2.23	1.91	2.51	2.23	1.91
GRADE FIVE	133.99	6.70	3.35	2.23	1.91	3.35	2.68	2.23	1.91	2.51	2.23	1.91
GRADE SIX	133.99	6.70	3.35	2.23	1.91	3.35	2.68	2.23	1.91	2.51	2.23	1.91

*Annual cost of pair of semester packages required for one year except for Grade Three where each semester package is considered separately.

This topic will be discussed again in the cost-effectiveness analysis and in the cost formulation for the dissemination planning. The topic of immediate importance is an estimate of the comparable costs of textbook materials. In a report prepared in March, 1981, Mr. Mark S. Carroll provided the following estimate of per-student textbook costs by grade:

Grade One	$28.15
Grade Two	32.65
Grade Three	32.20
Grade Four	28.25
Grade Five	34.95
Grade Six	27.05

These figures are based upon the provision of the Ministry of Education recommended textbooks at each level (there are seven of these for each of Grades One to Three and five for each of Grades Four to Six). The costs are based on the retail prices at the Government Bookstore.

The Fourth Education Project materials component has as its goal the achievement of significant reductions in textbook cost. Originally, there were plans to do this through increased printing of materials in Liberia, but the thrust of the materials project has shifted toward capturing the economies of scale available from bulk purchases of textbooks. In Table Five, a comparison has been made, by grade level, of the per-student costs at class sizes of twenty, forty, and sixty students of IEL materials, textbooks at current prices (A), textbooks at the reduced price (fifty percent of current charges) which is the goal of the educational materials project (B), and reduced priced textbooks used on a shared basis of one textbook to every two children (C).

The numbers in Table Five indicate the dramatic effect which class sizes have on the relative costs of the different types of instructional

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material. It is obvious that the alternative of a traditionally priced textbook for every child is by far the most expensive; this is true for any class size above twenty. For smaller classes (those with 10-12 students or less), the textbook alternative "A" may have some comparative advantage. However, both of the other textbook alternatives presented in Table Five are less expensive than is the IEL curriculum for the class sizes up to approximately twenty-five to thirty students. Beyond that size only the reduced-cost textbooks shared by students remains less expensive. Finally, at the sixty to seventy class size, the IEL alternative becomes less expensive than any of the three versions of the textbook alternative.

In reviewing Table Five it should be remembered that, while the textbook costs are subject to little variability except among the three alternatives, the IEL figures used are highly sensitive to the earlier assumptions concerning marginal production costs and materials life. If marginal printing costs should vary from 3 cents a page or the replacement rate from the two- and five-year cycles estimated by IEL staff, the costs of IEL materials could vary considerably. One task for the IEL project over the implementation planning period is to verify or, if necessary, refine these estimates so that they may be used with greater confidence.

The discussion to this point has dealt largely with an abstract analysis of IEL comparative costs. There is a need now to consider IEL implementation and its effect on costs in terms of the realities of the Liberian primary education system.

Primary school enrollment in 1983 is expected to total 105,265 of which an estimated 70,528 will be in government schools. There will be approximately 2,275 primary school teachers in these government primary schools, assuming a maintenance of the 31:1 student-teacher ratio which has prevailed in recent years. Historically, statistics have indicated that only 31 percent of <u>all</u> Liberian teachers are qualified; however, the qualified teachers tend to be concentrated in

TABLE FIVE

RELATIVE PER-STUDENT COSTS OF INSTRUCTIONAL MATERIALS

IEL versus Textbook Requirements
by Grade Level and Class Size

Grade Level Instructional Material	Number of Students in Class 20	40	60
GRADE ONE			
IEL	$ 5.91	$ 2.95	$ 1.97
Textbook (A)	9.38	9.38	9.38
Textbook (B)	4.69	4.69	4.69
Textbook (C)	2.35	2.35	2.35
GRADE TWO			
IEL	6.27	3.13	2.09
Textbook (A)	10.88	10.88	10.88
Textbook (B)	5.44	5.44	5.44
Textbook (C)	2.72	2.72	2.72
GRADE THREE			
IEL	6.11	3.07	2.04
Textbook (A)	10.73	10.73	10.73
Textbook (B)	5.37	5.37	5.37
Textbook (C)	2.68	2.68	2.68
GRADE FOUR			
IEL	6.70	3.35	2.23
Textbook (A)	9.42	9.42	9.42
Textbook (B)	4.71	4.71	4.71
Textbook (C)	2.36	2.36	2.36
GRADE FIVE			
IEL	6.70	3.35	2.23
Textbook (A)	11.65	11.65	11.65
Textbook (B)	5.83	5.83	5.83
Textbook (C)	2.91	2.91	2.91
GRADE SIX			
IEL	6.70	3.35	2.23
Textbook (A)	9.02	9.02	9.02
Textbook (B)	4.51	4.51	4.51
Textbook (C)	2.26	2.26	2.26

the high school programs so that current estimates of the percent of unqualified teachers at the primary level are as high as 80 to 85 percent.

The most detailed data on the Liberian educational system comes from the National Education Survey of 1978. The stability of the Liberian educational structure in recent years allows use of certain proportions from these data with a degree of confidence. Of importance to the IEL context is the fact that the 748 government elementary schools in the survey reported a total enrollment of 85,475 students for an average enrollment per school of 114 students. Since all but a small number of these schools had a full six-year cycle of primary classes, this indicates an estimated average class size only slightly in excess of 19 students. This is well below the class sizes which the earlier discussion revealed to be optimal for IEL materials use. When one considers the fact that these figures include the bimodal national pattern of large primary schools in urban areas and extremely small primary schools in rural areas, the issue of the fit of the IEL cost pattern to the reality of school and class size becomes even more important.

In Bong County, the initial site of the IEL experiment, the survey reveals even more useful information concerning the pattern of class sizes to which IEL will have to be adapted. Table Six depicts the distribution of class sizes by grade for the 42 government elementary schools in Bong County (four of the schools had no Grade Six class but all others reported data for all six grades of the elementary school cycle).

The data in Table Six present a very dramatic picture of the rate of attrition in the Liberian primary school system accentuated by the higher rates characteristic of a more rural county such as Bong. There is a dramatic decline between the size distribution of first- and second-year classes and a continuing significant decline from grade to grade thereafter. The 1978 survey data's continued relevance is supported

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by the 1982 educational statistics for the national enrollment pattern in government schools:

Grade One	29,067
Grade Two	21,144
Grade Three	17,710
Grade Four	14,383
Grade Five	12,060
Grade Six	9,865

Accepting a class size of sixty as the optimum for both PT and PL and ignoring the Grade One classes which exceed this, 81 percent of all Grade One classes shown in Table Six are below this optimum size. For Grade Two the proportion below the optimum reaches 93 percent and all classes of all other grades are smaller than the IEL optimum level. Remembering that a class size of thirty students represented an important transition point for the IEL materials-textbook comparison presented earlier, it is useful to see the proportions of classes which fall above and below that threshold.

For Bong County, forty percent or more of the Grade One and Grade Two classes are above this minimum size. However, from Grade Three onward, the distribution shifts significantly toward more small classes as indicated by the average class sizes of 22.4, 19.0, 15.6, and 15.1. The conclusion which must be drawn is that, at least for a rural county such as Bong, the IEL scale effects will not be realized in most classrooms and will have a marked cost advantage only in the earliest grades. Such a situation has very important implications for the analysis of IEL cost-effectiveness by grade level and should also be a factor in planning the dissemination. An example of the latter implication is that the priority for dissemination of IEL materials, in a case where only partial dissemination is affordable or where a phased dissemination is preferred, would be to start in those grades where the greatest cost

TABLE SIX

DISTRIBUTION OF CLASS SIZES, BY GRADE

BONG COUNTY, 1979

Grade Level	0-10	11-20	21-30	31-40	41-50	51-60	61-75	76-100	101-125	125+	Average Enrollment	% of Classes Below 60 Stud.	% of Classes Below 30 Stud.
GRADE ONE (42)	0	7	9	8	5	5	2	3	2	1	44.7	81	36
GRADE TWO (42)	- 5	16	4	8	6	-	3	-	-	-	26.8	83	60
GRADE THREE (42)	9	12	8	7	6	-	-	-	-	-	22.4	100	69
GRADE FOUR (42)	15	11	7	6	2	1	-	-	-	-	19.0	100	79
GRADE FIVE (42)	17	13	7	3	2	-	-	-	-	-	15.6	100	88
GRADE SIX (38)	17	12	5	3	1	-	-	-	-	-	15.1	100	89

advantages exist for IEL materials. An analysis, similar to that done here for Bong County, should be done for each of the counties of Liberia as well as a separate one for the Monrovia Consolidated School System.

To what extent do these figures relate to the ultimate benefits of extending IEL to conventional primary schools? This question cannot be answered definitively based on the above data because the benefits of IEL have never been stated as primarily of a cost-saving nature. Although such cost-savings may exist (for optimal size classes and from long-run readjustments in the student-teacher ratio), the major cost-offsets are of two types: learning enhancement and improved efficiency in the use of existing resources.

The improved achievement of children under IEL instruction, as anticipated by the IEL project, would represent a major increase in the effective use of the resources already being invested in primary education. A second effect of IEL could be a better utilization of staff and facilities at secondary schools as better prepared students graduate from primary school programs.* Finally, it should be recognized that the IEL program, if successful, will create enrollment patterns in the future which are more complementary to the comparative cost advantages of IEL materials. For example, improved learning in earlier grades should increase retention and reduce grade repetition with the result that class sizes at the higher grades will increase and thus approximate more closely the optimal class sizes where IEL materials costs compare most favorably with those of the textbook alternatives.

A final issue is the aggregate cost of IEL materials for initial distribution and in annual recurrent costs. Using the Bong County data as approximations of a national average, it is possible to estimate the

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*A possible negative effect could occur if IEL or any other improvement in primary education should accelerate social demand for secondary education beyond the level which the government can afford and what the demand of the labor market can justify.

cost of IEL materials distribution to all government elementary schools based upon the 1982 enrollment statistics. This is an extremely conservative assumption of the national distribution pattern, but helps offset the possibly optimistic assumptions made earlier about marginal printing costs and material life, as well as the effect of the skewness of the enrollment pattern toward smaller class sizes. Table Seven presents the results of these calculations.

A cost per student of IEL materials is derived from the cost data originally presented in Table Three, divided by the average class sizes given in Table Six. The result is multiplied by the total enrollment at each grade level to give a total IEL materials cost for each grade level. The sum of these amounts for original publication cost and for annual recurrent cost (under the IEL assumptions of material life) are $2,561,500 and $565,063 respectively. These are marginal costs only. They do not include the cost of any distribution expense and they are exclusive of any on-going revision/adaption work in terms of the materials' subject matter.

Similar calculations can be made for the annual recurrent costs of the three textbook options discussed earlier. The figures, as shown in Table Eight, are $1,057,838, $528,919, and $264,460. The most important implication to be drawn from Table Eight is, however, the pattern of relative advantage for the IEL material. Using the data as adjusted for the realities of the class size distribution and the current enrollment levels, the IEL materials are seen to have an advantage at earlier grades, but to lose their comparative advantage (especially relative to the low-cost textbook/multi-use alternatives) at the higher grades.

Another reality of the Liberian context which has not been discussed adequately to this point is the absorptive capacity of the Ministry of Education for any new recurrent costs. Both the textbook and IEL alternatives represent an increase from a current base of materials cost which is close to zero in many schools. The recent USAID/Government

TABLE SEVEN

IEL MATERIALS COST, ORIGINAL AND ANNUAL RECURRENT

Adjusted for Class Size and Total Enrollments, 1982

Grade Level	1 Original Cost	2 Average Class Size	3 Original Cost per Student (1 ÷ 2)	4 Enrollment	5 Total Original Cost (3 x 4)	6 Annual Cost	7 Annual Cost per Student (6 ÷ 2)	8 Total Annual Cost (7 x 4)
GRADE ONE	$446.70	44.7	$ 9.99	29,067	$ 290,379	$118.14	$2.64	$ 76,737
GRADE TWO	482.70	26.8	18.00	21,144	380,592	125.34	4.68	98,954
GRADE THREE (I)	259.35	22.4	24.15	17,710	427,697	66.27	5.47	96,874
GRADE THREE (II)	281.58					56.32		
GRADE FOUR	669.96	19.0	35.26	14,388	507,145	133.99	7.05	101,400
GRADE FIVE	669.96	15.6	42.95	12,060	517,971	133.99	8.59	103,595
GRADE SIX	669.96	15.1	44.37	9,865	437,710	133.99	8.87	87,503
TOTAL					$2,561,500			$565,063

TABLE EIGHT

IEL VERSUS TEXTBOOK MATERIAL COSTS, BY GRADE LEVEL

Adjusted for Class Size and Total Enrollments, 1982

Grade Level	Original Cost*				Recurrent Cost*			
	Total IEL	TEXTBOOK "A"	TEXTBOOK "B"	TEXTBOOK "C"	Annual IEL	TEXTBOOK "A"	TEXTBOOK "B"	TEXTBOOK "C"
GRADE ONE	$ 290,379	$ 818,236	$ 409,118	$204,559	$ 76,737	$ 272,745	$136,373	$ 68,186
GRADE TWO	380,592	690,352	345,176	172,588	98,954	230,117	115,059	57,529
GRADE THREE	427,697	570,262	285,131	142,566	96,874	190,087	95,044	47,522
GRADE FOUR	507,145	406,320	203,160	101,580	101,400	135,440	67,720	33,860
GRADE FIVE	517,977	421,497	210,749	105,374	103,595	140,499	70,250	35,123
GRADE SIX	437,710	266,848	133,424	66,712	87,503	88,949	44,475	22,237
TOTAL	$2,561,500	$3,173,515	$1,586,758	$793,379	$565,063	$1,057,838	$528,919	$264,460

NOTE: Textbook Alternatives "A" - Current Ministry of Education Bookstore prices.
"B" - Half-price textbook goal of World Bank Loan project.
"C" - "B" with added assumption of one book for every two students.

*Sums may not equal totals because of rounding.

of Liberia educational sector assessment stressed the need for extreme caution in terms of assumptions concerning Liberian capacity to absorb incremental project costs. The Fourth Education Project educational materials component will be testing the idea of parentally-financed textbooks during the next year. Whether such marketing of educational materials will work remains to be seen, but it is an attractive alternative and is being considered for IEL as well. However, the IEL system imposes an additional marketing disadvantage in that parents, rather than buying a book, will be asked to pay an instructional materials fee because of the multi-year use of materials. School fees are an extremely sensitive issue in Liberia and the initial introduction of the materials fee undoubtedly will face some "consumer resistance."

As has been indicated throughout this section, the materials cost component of IEL, while not representing the sole impact of IEL on educational costs, is certainly the major issue in considering its potential cost effectiveness. The data presented here have indicated that the IEL system is designed to minimize per-student costs at fairly large class sizes. Because class sizes in Liberian primary schools tend to approximate these optimal dimensions only at the lower grades, the cost-advantage of IEL materials declines as the grade level increases. While these initial results are provisional and will be expanded upon in future reports, three key questions can be identified. First, will the cost of materials - IEL materials or textbooks - be sufficiently effective in terms of student learning to justify their costs? Second, even if effective, should IEL be disseminated only (or at first) to those schools and/or grade levels where an obvious cost advantage exists? And third, can the IEL system be restructured to allow for greater cost flexibility (without an offsetting decline in learning effectiveness) so that in those schools and/or classes where total enrollment is low, the IEL system can still be instituted in a comparatively inexpensive manner?

FACILITIES AND EQUIPMENT COSTS

As noted earlier, the only facilities and equipment items which will represent a marginal cost of the IEL program over the conventional primary system of instruction are the "semester package" box, the group blackboard, and the individual lap boards. The expenses for a lockable room and for the class blackboard are not assigned to IEL under the assumption that these or equivalent facilities already exist in most schools. The unit costs of these items are $26.50 for the "semester package" box (based on a contract with the LOIC for an initial order of 250); $3.44 for the group blackboard at current prices; and $.20 per lap board (based on 40 lap boards cut from a $7.50 plank plus an additional charge for labor and equipment).

To estimate the quantity required one must consider the ratios of item use to student numbers. The "semester package" box is used at a rate of one per class per semester for any student number between 1 and 60 or 70 (depending on PT or PL level). One group blackboard is used in each PT and PL class for at most every 7 students. One lap board is required for each student in each class. Using the Bong County distribution of class size once again, the following quantities may be derived as the required number of each item at each grade in an average school:

Grade	"Semester Package" Boxes	Group Blackboards	Lap Boards
One	2	7	45
Two	2	4	27
Three	2	4	23
Four	2	3	19
Five	2	3	16
Six	2	3	15

Multiplying the quantities of each item by its original cost gives the following distribution of costs by grade level:

Grade	"Semester Package" Boxes	Group Blackboards	Lap Boards	Total
One	$ 53.00	$24.08	$ 9.00	$ 86.08
Two	53.00	13.76	5.40	72.16
Three	53.00	13.76	4.60	71.36
Four	53.00	10.32	3.80	67.12
Five	53.00	10.32	3.20	66.52
Six	53.00	10.32	3.00	66.32
Total	$318.00	$82.56	$29.00	$429.56

Assuming a five-year life for these items and using the earlier enrollment figures for the calculation of a per-student cost for each grade, the following original and annual recurrent cost of these materials can be derived:

Grade	Original Cost Per Student	Annual Recurrent Cost Per Student	Total Original Cost	Total Recurrent Annual Costs
One	$1.93	.39	$ 56,099	$11,220
Two	2.69	.54	56,877	11,375
Three	3.19	.64	56,495	11,299
Four	3.53	.71	50,772	10,154
Five	4.26	.85	51,376	10,275
Six	4.39	.88	43,307	8,661
Total			$314,926	$62,984

Thus, the equipment expense incurred for a dissemination of IEL to all government primary schools would be $314,926 initially and the annual increase in recurrent costs to the Ministry of Education (or to parents if these items are financed via school fees) will be $62,984.

These amounts are, of course, subject to the assumptions concerning original prices, use per student, length of use, the class size distribution, and the total enrollment in government primary schools. A change in any of these assumptions would modify the totals noted above. However, the assumptions used in the calculations appear reasonable and the approximate scale of the totals is precise enough for use for planning purposes.

ADMINISTRATIVE AND SUPERVISORY COSTS

At the time of this report, no detailed plan existed for the supervision of IEL schools or classrooms after introduction of IEL materials. IEL staff and Ministry of Education personnel appear to have reached agreement on the requirement for some additional supervisory assistance, at least during the first year in which the IEL methodology is used by teachers. The cost analysis of these activities must await the final design of the supervisory plan.

TEACHER TRAINING

Also in preparation is a design for in-service training for the principals and teachers of IEL schools. Issues which remain to be resolved are the length of training, the qualifications of trainers, and whether one or more sessions of training will be required (perhaps one before and one after the initial year of IEL use). However, the process of design for the 1983 experimental sessions has advanced sufficiently that some unit costs may be approximated.

Participant support, based on an estimated attendance of 100 teachers, has been budgeted at $10-$12 per participant for transportation, $5.00 per day per participant for board, and $7.00 per participant per week for lodging. Instructional and support staff total costs are budgeted in the range of $2,250 to $2,500 for the one-month period. Stationery, other materials for the workshop, and a contingency account would raise the total by as much as another $1,000. The final two bids submitted for the OC training totaled $20,995 and $23,900 with few differences in the non-instructional services provided.

These estimates, although made for the OC teacher training program, are fully applicable to the IEL teacher training effort. The only exception for 1983 is that IEL staff will present all training instruction and, thus, no explicit additional payment will be required for instructional services. There are two items which are not yet included in these teacher training budgets. The first is a payment of a stipend to classroom teachers for participating in the training sessions. Because the IEL training in the dissemination plan will not improve the teachers' certification level and thereby their salary, there is a requirement to provide some immediate stipend as an incentive for participation.

The second item not in the budgets is materials cost. For IEL, the training program will involve the distribution of two hardback books/teacher guides which have a total cost of production of $6.93 per participant. To provide OC teacher trainees with a full set of textbooks for a particular grade level will vary between $27.05 and $34.95 depending on the grade level.

The final plan for teacher training for IEL must be worked out jointly with the plan for instructional supervision since these two activities are, to a certain degree, substitutes for one another. The final costs for IEL teacher training will be calculated after completion of these plans.

SUMMARY AND CONCLUSIONS

In this report a justification for a comparative cost approach to the study of IEL costs has been presented as have initial estimates of the comparative costs of the IEL and conventional instructional methodologies. Some preliminary conclusions may be stated at this time.

First, the comparison of IEL with the conventional Liberian primary school program (as characterized by the SQ schools) indicates that the introduction of the IEL system will involve substantial costs - both initial and recurrent. The ultimate decision over the value of IEL will be made on the basis of whether the policymakers' subjective judgment is that the IEL instructional gains (as measured by achievement tests, retention rates, or other criteria) are adequate to justify the level of expenditure.

A second conclusion supported by the present data is that the comparison of IEL use with textbook use will depend both on cost factors and effectiveness factors. The cost factors will depend on potential cost savings in production which are currently being sought for both systems. In addition, the results on scale effects suggest that the textbooks may have some initial cost advantages for the upper primary grades, but that these will be reduced and possibly eliminated as enrollments in these grades increase over time. These increases may occur slowly as a result of increases in primary school age cohort size or improvements in the rates of attendance. However, successful implementation of IEL at the early grades should accelerate the rate of enrollment increases in the later primary grades.

The scale effect of IEL has been shown to have two important implications for this cost study. First, the differential class sizes from Grades One to Six will mean that the cost advantage of IEL will be greatest at the lower grades. With an assumption of no variation in IEL effectiveness by grade, this means that, all other things equal, the cost-effectiveness of IEL will be greatest at the early grades. Second, and as was discussed earlier, the scale effect should be taken into account in any partial or phased dissemination plan.

In the next three reports more specific findings on these and related topics will be available. In addition, the progress which will take place in dissemination planning in coming months will allow for a more detailed costing of potential IEL dissemination alternatives. The final conclusion of this initial report is that the cost estimates which presently exist justify the continued development of the IEL project to allow for the most complete and objective evaluation of the IEL system's potential to assist with improving Liberia's primary schools.

III

Internal Economies in the Liberian Improved Efficiency of Learning (IEL) Project

Report No. 2 of the IEL Cost Analysis Project

Douglas M. Windham

March 1983

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INTERNAL ECONOMIES IN THE LIBERIAN
"IMPROVED EFFICIENCY OF LEARNING" (IEL) PROJECT
Report No. 2

In Report No. 1 of the IEL Cost Analysis Project, the primary purpose was to determine the unit costs of the main factors within the IEL curriculum methodology and to contrast these costs with the textbook alternatives currently available and planned for the Liberian Ministry of Education. From this analysis two major issues of internal cost efficiency were identified. The first was the question of the relative costs of photocopying versus printing as the means for eventual reproduction of the IEL classroom materials. The second was the problem of adapting the IEL semester packages to class sizes less than the optima of 60 and 70 students for which the PT and PL semester packages were originally designed.

This report will attempt to resolve these two costing issues so as to identify a proper costing structure for IEL. This structure will be used in the later cost-effectiveness and dissemination costing reports. The comparison of costs of material copying versus printing is a fairly straightforward one. Sinimax Corporation of Monrovia has quoted a price of $.03 per page for 5,000 to 10,000 copies (exclusive of paper costs of approximately $.01 per page) and of $.03 per page for 10,000 or more copies (inclusive of paper cost). Sabanoh Press of Monrovia has quoted printing costs of $.08 per page for 500 to 1,000 copies; $.06 per page for 1,000 to 5,000 copies; and $.05 per page for 5,000 copies or more. While larger quantities of printing would allow for the negotiation of lower costs per page, a basic rule of thumb derived from U.S. based printing concerns is that for up to 10,000 copies of any one original, photocopying is always less expensive; for 10,000 to 20,000

copies printing and photocopying increasingly are of comparable costs and above 20,000 printing is the less expensive alternative.

These figures do not take into account two realities of the IEL materials. First, the IEL modules and booklets include a substantial quantity of drawings. While the inclusion of drawings has no effect on the photocopying costs, it does increase printing costs. Second, photocopying costs are stated for a total number of copies regardless of the number of originals while printing cost-quantity relationships are stated in terms of copies of a single original. Thus, to take advantage of the quantity discounts on photocopying, it is necessary to make only 10,000 total copies of a set of originals while one would have to make more than 10,000 copies of a single original to achieve comparable price economies from printing the materials.

To determine which, if any, items among the IEL materials require duplication in sufficient numbers to make printing a reasonable alternative necessitates the calculation of the projected requirements for IEL materials at each grade level. The assumption made is that IEL would be disseminated to all public elementary schools. Table One presents the material requirements for the IEL instructional program by grade level and type of materials. The table indicates the number of originals and copies of originals planned for a semester package at each grade level for both PT (programmed teaching) and PL (programmed learning) instruction.

Because of the uncertainty concerning the exact number of public elementary school classrooms at each grade level, it was necessary to make approximations based on the 1978 National Education Survey. By the time of the calculation of implementation costs for Report No. 4 in the IEL Cost Analysis Project, it is expected that the 1981 school data will be in a form to permit a more precise estimate of these numbers. For present purposes, the figure of 748 public elementary schools was taken as a base. While the 1978 Survey does not report

TABLE ONE
MATERIAL REQUIREMENTS FOR IEL
(PER GRADE, PER SEMESTER)

Item	Original	Per Original: Copies	Per Original: Number of Classrooms	Per Original: Total Copies
PROGRAMMED TEACHING				
GRADE ONE				
Modules	20	1	825	825
Review Booklets	4	15	825	12,375
Practice Booklets	14	5	825	4,125
Semester Test	1	1	825	825
GRADE TWO				
Modules	20	1	740	740
Reading Booklets	1	15	740	11,100
Review Booklets	4	15	740	11,100
Practice Booklets	14	5	740	3,700
Semester Test	1	1	740	740
GRADE THREE (I)				
Modules	20	1	705	705
Reading Booklets	1	15	705	10,575
Review Booklets	4	15	705	10,575
Practice Booklets	14	5	705	3,525
Semester Test	1	1	705	705
PROGRAMMED LEARNING				
GRADE THREE (II)				
Modules	50	7	705	4,935
Student Guides	1	10	705	7,050
Test Booklets	10	7	705	4,935
Test Answer Keys	1	1	705	705
Block and Semester Tests	1	1	705	705
GRADES FOUR, FIVE, AND SIX				
Modules	60	7	660	4,620
Student Guides	1	10	660	6,600
Test Booklets	10	7	660	4,620
Test Answer Keys	1	1	660	660
Block and Semester Tests	1	1	660	660
Arts and Crafts Manual	1	1	660	660

highest grade level of instruction for government schools, it does report this for the total school population of 1,088 elementary schools as shown below:

Highest Elementary Grade Level	Number of Schools	Proportion of Total
First	11	.01
Second	51	.05
Third	66	.06
Fourth	150	.14
Fifth	132	.12
Sixth	678	.62

It was also estimated that 10 percent of all government primary schools had an average of two Grade One classes. Because the public schools are believed to have a higher percentage of full six-grade primary schools, an average was derived to be used for the three upper grades. The estimates used in Table One are the following:

Grade One - 825 classrooms
Grade Two - 740 classrooms
Grade Three - 705 classrooms
Grades Four, Five, and Six - 660 classrooms

It should be stressed here that while these estimates should provide useful approximations for the present calculations of materials requirements, more definitive data will be required for the implementation budgetary analysis planned for Report No. 4.

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Returning to Table One, it may be seen that only the review booklets in Grade Two and the first semester of Grade Three exceed the 10,000 minimum for the consideration of the printing alternative. No PL materials require more than 7,050 copies in the original production schedule. However, even PT items cited require only 10,575 to 12,375 copies; these quantities are still in the range where photocopying is at least no more expensive than printing. The conclusion which must be accepted is that no internal economies exist for the IEL project (as presently designed) in terms of the printing alternative.

A different conclusion might be reached if the IEL methodology and materials were to be disseminated to all schools rather than only to public schools. This would increase the materials demand by approximately 50 percent. This would raise the initial reproduction requirement for the PT materials cited above to the range of 15,000 to 18,000 copies. However, there are no plans at present for distribution of IEL materials to the mission and private elementary schools. In addition, a phased implementation of IEL by school types, geographic regions, or grade level would reduce the initial materials duplication requirements and thus diminish the feasibility of the printing alternative still further.

All of these calculations are sensitive to the relative prices of photocopying to printing. Any relative increase in photocopying costs would reduce the quantity of copies required to justify a change to the printing alternative. While the long-term trend has been one of relative reduction of photocopying costs, the current cost levels are at or close to a minimum with some expectations for real as well as inflationary increases over the next five to ten years. The cost and price expectations for printing are more uncertain, but the possibility of a relative price decline for printing does exist.

In view of the above, IEL planning should maintain the policy of photocopying as the exclusive duplication medium while monitoring relative printing costs. Careful consideration will also have to be given in the near future as to whether the Ministry of Education

should plan on incorporating materials duplication fully into its own operation or should maintain partial or full dependence on external agents such as Sinimax.

As was noted in Report No. 1, a major cost inefficiency in the present design of the IEL system is the inflexibility of materials requirements as the number of students in a class varies. For example, in PT instruction in Grade Two there is a requirement for 15 copies of the four review booklets per semester. The Handbook for IEL Instructional Management (p. 117) suggests the following as the recommended pattern of group numbers and sizes as class size varies:

Class Size	Number of Groups	Group Size
10	1	10
20	1	20
21	2	10/11
40	2	20/20
41	3	13/14/14
60	3	20/20/20
61	4	15/15/15/16

The Handbook explains this patterning as follows:

> In establishing direct instruction groups, teachers make them as large as possible without exceeding the maximum size of 20 children. The purpose in doing so is to limit the number of direct instruction sessions required each day. The fewer the number of sessions of direct instruction, the more time there is to monitor and supervise review and practice activities.

This curricular decision has an important cost impact. Simply stated, the IEL methodology involves a choice between number of groups and group size (with group size determining the number of copies required

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of the IEL reading and review booklets). The recommended system of organization places a premium on the minimization of the number of groups, and thus the required number of booklets is the same for classes of 15 to 60 students. However, if an arrangement of four groups is acceptable for a class of 61, it is worth considering whether the same number of groups — with fewer students — should not be acceptable for smaller class sizes. An advantage of keeping group size rather than number of groups small is that materials demand is reduced and sharing of booklets (required when more than 15 students are in a group) would occur only in classes above 60 students. The revised distribution would be as follows:

Class Size	Number of Groups	Group Size
10	4	2/2/3/3
20	4	5/5/5/5
21	4	5/5/5/6
40	4	10/10/10/10
41	4	10/10/10/11
60	4	15/15/15/15
61	4	15/15/15/16

This alternative structure presents an opportunity for significant cost savings in the smaller class sizes where, with the original IEL materials distribution structure, IEL has been shown to be most costly relative to the textbook alternatives. With a cost per PT reading booklet of $1.20 in Grade Two and $2.40 in Grade Three and a cost per PT review booklet of $2.22, the annual per-class savings from using the revised structure in a class of 20 students would be $35.52 in Grade One, $40.32 in Grade Two, and $22.56 for the PT semester of Grade Three. For a class of 40 students, the respective annual savings would be $17.76, $20.16, and $11.28.

The ultimate decision on design of the PT instructional materials system must rest with the IEL curriculum specialists. The purpose of this discussion is to illustrate a cost factor which may have been overlooked in the original design. Shorter direct instructional periods with smaller groups may be as effective as longer direct instructional periods with larger groups. This alternative should at least be considered as should the effect of materials sharing (required for class sizes above 45 in the present PT system) versus the effect of using four direct instructional groups rather than three for these larger classes.

For the PL classrooms the design of alternatives to the existing strategy of materials use is slightly more complicated. The PL modules and module test booklets are designed for the use of seven-member groups (with up to a maximum of 10 groups). If one takes the 10 groups as an alternative standard, then there would be a need for one module and module test booklet for every 10 students. For student guides in the PL system, the idea is to have one for each group. Under the previous assumption of a standard group number of 10, the number of copies required would be unaffected by the proposed change in the materials use strategy.

Table Two presents the effect of implementation of these material use alternatives for PT and PL (by grade level) in terms of the quantities of copies required and the total duplication costs. For the PT grades, the effect is to reduce the required quantities and costs of review and reading booklets. For the PL grades reductions are made in the quantities of copies and costs related to modules and module test booklets.

Because of the great number of originals of modules and module test booklets, the alternative materials use plan has a dramatic effect on the total duplication costs at the PL levels. For the PL semester of Grade Three, the savings amount to $198.00 for a class of 20 students and $118.80 for a class of 40 students. For Grades Four, Five, and

TABLE TWO
MATERIALS REQUIREMENTS
ORIGINAL AND ALTERNATIVE IEL MATERIAL DISTRIBUTION SYSTEMS
(PER GRADE LEVEL, PER SEMESTER)

			Copies			Duplication Costs		
			Original IEL	IEL Alternatives		Original IEL	IEL Alternatives	
Item	Originals	Avg. # of Pages	(All Class Sizes)	20 Stud.	40 Stud.	(All Class Sizes)	20 Stud.	40 Stud.
PROGRAMMED TEACHING								
GRADE ONE								
Modules	20	80	1	1	1	$ 48.00	$ 48.00	$ 48.00
Review Booklets	4	74	15	5	10	133.20	44.40	88.80
Practice Booklets	14	20	5	5	5	42.00	42.00	42.00
Semester Test	1	5	1	1	1	.15	.15	.15
TOTAL						$223.35	$134.55	$178.95
GRADE TWO								
Modules	20	80	1	1	1	$ 48.00	$ 48.00	$ 48.00
Reading Booklets	1	40	15	5	10	18.00	6.00	12.00
Review Booklets	4	74	15	5	10	133.20	44.40	88.80
Practice Booklets	14	20	5	5	5	42.00	42.00	42.00
Semester Test	1	5	1	1	1	.15	.15	.15
TOTAL						$241.35	$140.55	$190.95
GRADE THREE (I)								
Modules	20	80	1	1	1	$ 48.00	$ 48.00	$ 48.00
Reading Booklets	1	80	15	5	10	36.00	12.00	24.00
Review Booklets	4	74	15	5	10	133.20	44.40	88.80
Practice Booklets	14	20	5	5	5	42.00	42.00	42.00
Semester Test	1	5	1	1	1	.15	.15	.15
TOTAL						$259.35	$146.55	$202.95

CONTINUED

CONTINUED - TABLE TWO

Item	Originals	Avg. # of Pages	Copies: Original IEL (All Class Sizes)	Copies: IEL Alternatives 20 Stud.	Copies: IEL Alternatives 40 Stud.	Duplication Costs: Original IEL (All Class Sizes)	Duplication Costs: IEL Alternatives 20 Stud.	Duplication Costs: IEL Alternatives 40 Stud.
PROGRAMMED LEARNING								
GRADE THREE (11)								
Modules	50	24	7	2	4	$252.00	$ 72.00	$144.00
Student Guides	1	2	10	10	10	.60	.60	.60
Test Booklets	10	12	7	2	4	25.20	7.20	14.40
Test Answer Keys	1	48	1	1	1	1.44	1.44	1.44
Block and Semester Tests	1	78	1	1	1	2.34	2.34	2.34
TOTAL						$281.58	$ 83.58	$162.78
GRADES FOUR, FIVE & SIX								
Modules	60	24	7	2	4	$302.40	$ 86.40	$172.80
Student Guides	1	2	10	10	10	.60	.60	.60
Test Booklets	10	12	7	2	4	25.20	7.20	14.40
Test Answer Keys	1	48	1	1	1	1.44	1.44	1.44
Block and Semester Tests	1	78	1	1	1	2.34	2.34	2.34
Arts & Crafts Manuals	1	100	1	1	1	3.00	3.00	3.00
TOTAL						$334.98	$100.98	$194.58

Six the savings, per semester, would amount to $234.00 for a class of 20 students and $140.40 for a class of 40 students. The size of these duplication cost economies suggests that this or some other form of alternative material distribution system may be a practical means to adapt the IEL system to the realities of the Liberian distribution of class sizes by grades.

Further support for this assertion may be found in Table Three. Here the "IEL - alternative" is compared to the IEL original material use system as well as to the three alternative textbook systems discussed in Report No. 1. Textbook alternative "A" represents the current textbook price schedule and is based on the distribution of a full set of texts to each student. Alternative "B" represents the expected savings in textbook costs from the Fourth Education Project instructional materials component; again, a full set of texts are assumed to be allocated to each student. Alternative "C" incorporates the reduced price textbook savings with the assumption of the school having one set of textbooks for every two students.

The comparisons in Table Three are in terms of per-student annual costs. Annual costs are calculated from Table Two by means of an assumed materials life of two years for PT modules and five years for all other materials. The PT and PL semesters of Grade Three are combined for the Grade Three IEL costs.

The two IEL alternatives are assumed to be of equal cost for the 60-student classroom. In fact, for the PL levels, the original IEL system is slightly more expensive up to the 70-student level, but the difference at the 60-student level is a minor one.

The most efficient instructional materials alternative is marked with an asterisk (*) for each grade-level/class-size combination. In only 4 of the 18 possible combinations is there a textbook alternative (always alternative "C") which is less expensive than the IEL alternative materials use system. These are for PT Grades One, Two, and Three

TABLE THREE
RELATIVE ANNUAL PER-STUDENT COSTS OF INSTRUCTIONAL MATERIALS
IEL VERSUS TEXTBOOK REQUIREMENTS
(BY GRADE LEVEL AND CLASS SIZE)

Grade Level and Instructional Material Alternative	Number of Students in Class		
	20	40	60
GRADE ONE			
IEL - Original	$ 5.91	$ 2.95	$ 1.97*
IEL - Alternative	4.13	2.51	1.97*
Textbook (A)	9.38	9.38	9.38
Textbook (B)	4.69	4.69	4.69
Textbook (C)	2.35*	2.35*	2.35
GRADE TWO			
IEL - Original	6.27	3.13	2.09*
IEL - Alternative	4.25	2.63*	2.09*
Textbook (A)	10.88	10.88	10.88
Textbook (B)	5.44	5.44	5.44
Textbook (C)	2.72*	2.72	2.72
GRADE THREE			
IEL - Original	6.11	3.06	2.04*
IEL - Alternative	3.86	2.19*	2.04*
Textbook (A)	10.73	10.73	10.73
Textbook (B)	5.37	5.37	5.37
Textbook (C)	2.68*	2.68	2.68
GRADE FOUR			
IEL - Original	6.70	3.35	2.23*
IEL - Alternative	2.02*	1.95*	2.23*
Textbook (A)	9.42	9.42	9.42
Textbook (B)	4.71	4.71	4.71
Textbook (C)	2.36	2.36	2.36
GRADE FIVE			
IEL - Original	6.70	3.35	2.23*
IEL - Alternative	2.02*	1.95*	2.23*
Textbook (A)	11.65	11.65	11.65
Textbook (B)	5.83	5.83	5.83
Textbook (C)	2.91	2.91	2.91
GRADE SIX			
IEL - Original	6.70	3.35	2.23*
IEL - Alternative	2.02*	1.95*	2.23*
Textbook (A)	9.02	9.02	9.02
Textbook (B)	4.51	4.51	4.51
Textbook (C)	2.26	2.26	2.26

*Least expensive alternative for grade level and size combination

for 20 students and Grade One for 40 students. However, the same textbook alternative is less costly than the original IEL system at all grade levels for classes of 20 or 40 students.

Thus, the effect of the IEL materials use alternative is to extend the relative economy of the IEL curriculum technology to smaller class sizes at the higher grade levels. This is an especially significant change because, as was shown in Report No. 1, the tendency in Liberian elementary schools is for the earlier grade levels to be much larger in size than the later grade levels. The conclusion reached in Report No. 1 was that the Ministry of Education should consider a phased implementation of IEL beginning with the lower grades and advancing to the higher grades as class sizes expanded at those levels. The figures presented here suggest that an alternative strategy would be to modify the IEL semester package for the PL levels for those schools which have smaller class enrollments. In this way, the IEL system is no more costly than any of the textbook alternatives.

The specific alternative presented here to the original IEL system of materials use is illustrative only. The IEL curriculum specialists are, of course, the final arbiters of any modification to the system. The purpose of this exercise has been to illustrate one possible means of overcoming an existing internal inefficiency of the IEL system when it operates with small class sizes.

To summarize, the two internal economies studied in this report yield quite different conclusions. The quantity of copies of original IEL materials appears insufficient to realize the cost savings implicit in the economies of scale related to the printing alternative. In contrast, it does appear that sufficient economies can be achieved if one modifies the fixed semester package approach to IEL materials distribution. While this change must be considered in terms of possible increased complexity in classroom management and/or possible reduced student achievement, its significant effect on the relative costliness of IEL at all levels, but most especially at the PL levels, is encouraging.

A point which might be overlooked is that these two internal economies are linked. The change in IEL material use brought about by the adaptation of the semester package to smaller class sizes is achieved by reducing the number of copies made of certain originals. The ultimate effect is to reduce even further the possibility that the printing option will prove to be an efficient means of materials duplication.

IV

The Relative Cost-Effectiveness of the Liberian Improved Efficiency of Learning (IEL) Project

Report No. 3 of the IEL Cost Analysis Project

Douglas M. Windham

June 1983

receipt of an educational degree); and (3) those costs and effects which cannot be transformed into monetary value in any collective manner (such as subjective or psychic happiness or unhappiness).

In the first form, the comparison of costs and effects is quite easy since the two measures are both in terms of the same numeraire, that is, the same unit of measurement (in this case, money). Where costs and effects both exist in monetary form, a simple rate of return or present value of benefit/cost calculation will yield a statistic which will identify the success or failure of the project or program.

The second form of costs and effects also allows for the use of the traditional models of investment analysis. However, in this case debate may exist over the proper values for transforming non-monetary effects (i.e., number of graduates) into monetary effects (i.e., increases in expected future national or personal income).

It is with the third form of costs and effects that the greatest difficulty arises in regard to interpretation of project or program success, since it is impossible to create a simple summary statistic when the costs and effects are in dissimilar units of measurement. This "apples and oranges" dilemma is not resolved if, as in the case of the IEL project, costs remain in a monetary form while effects are measured in terms of an achievement test score.

The standard solution to this problem is to study a set of alternative projects or programs and to create a cost-effectiveness ratio. This is done by holding costs constant and identifying the alternative which shows the greatest effectiveness, or by standardizing effectiveness and identifying the

alternative with the lowest cost. This procedure requires similarity of costs and of effects among the alternatives, but not that costs and effects be measured in the same way. To appreciate why this approach to cost-effectiveness cannot be used in the IEL evaluation, it is necessary to review the basic design of the evaluation structure.

Three types of schools were identified for comparison, with five schools of each type existing at the time of the 1982 evaluation. The first type of school included those which were identified as using the IEL programmed teaching (PT) materials for Grades One, Two, and the first half of Grade Three and the programmed learning (PL) materials in the remainder of Grade Three and Grade Four. (The IEL system is being extended to the full six years of elementary school, but at the time of the evaluation the fifth and sixth grade materials were still undergoing development.) The IEL schools also benefited from special systems of teacher training and supervision.

The second type of school selected was the status quo (SQ) school which is supposed to represent the "typical" non-metropolitan Liberian elementary school. No special teacher training or supervision was provided to these schools other than the administration of practice tests to familiarize the students with the type of test (but not the content) to be used as the achievement examination.

Recognizing that the funds expended on IEL could be used for enrichment of the traditional, teacher-oriented curriculum, the evaluation design suggested that a third type of school, the optimum conventional (OC) school, be included. These schools were to receive a full set of regular textbooks, as well as teacher training and supervision equivalent to that provided to

the IEL schools. Thus, the final design would allow for the use of SQ schools as a base line (untrained teachers, no or few textbooks, and no supervision) against which the alternatives of the IEL curricular strategy and of the OC enriched (training, textbooks, and supervision) traditional curricular strategy could be compared.

Unfortunately, both for students and researchers, the OC schools did not receive the intended improvements. At the time of the 1982 evaluation, the only characteristic that distinguished the OC from the SQ schools was that the OC teachers had received a three-week training course in 1981.

From this description of the evaluation design, it can be seen that no *ex post* standardization of costs or effects can be achieved. One cannot compare $1 worth of IEL schooling with $1 worth of OC or SQ schooling, or compare the cost of one percentage point of IEL achievement with the cost of one percentage point of OC and SQ achievement. What one can do is to compare cost *differences* with achievement *differences*. One might find, for example, that the IEL school costs more but also promotes greater achievement. (Note: If an alternative costs more and achieves less, it is obviously an inferior choice; and, if it costs less and achieves more, it is obviously a superior choice.) Where both costs and achievement are greater, the ultimate judgment involves a decision based on what is called cost-utility analysis. Someone--researcher, policymaker, or whoever--must decide, based on his or her own utility values of costs and achievement, whether the additional costs are justified by the additional achievement. Since it has been shown that the IEL project is not less expensive in most forms and scales of operation than the OC textbook alternative (and never less expensive than the

SQ alternative), the only justification for IEL must be in terms of superior performance.

Before proceeding to the data analysis, a point should be made concerning the definition of achievement in this evaluation. Any educational program can be expected to have effects in terms of cognitive achievement, attitudinal change, and student behavioral adaptation. Only the first of these three effects have been measured in this evaluation, and the reader should bear in mind that the "effects" discussed here are not exhaustive of the potential effects of the three school types. Also, the cognitive achievement results themselves are analyzable only in terms of two dimensions: differences in mean test scores and differences in the variation within the full distribution of test scores. The standard deviation measure will be used as a proxy for a learning "equality" standard, while the difference in mean test scores among the three types of school populations will be used as a learning "gain" standard.

COST AND ACHIEVEMENT DATA

Table One presents the data on annual cost of IEL materials. These costs are based on the expense of producing a full year's package of modules and support materials. The "IEL" and "Conservative" estimates differ solely in terms of the expected life of the materials as they are used in the classroom. The figure 2*, which appears under the conservative estimate of expected life for the PT modules in Grades One, Two, and Three, denotes a ten percent increase in wastage over that assumed in the IEL estimate. Since later analysis will be based on the IEL estimate, one must remember that actual cost-in-use may be higher than the figures presented indicate.

TABLE ONE

ANNUAL COST OF IEL MATERIALS

Item	Total Pages	Original Cost	IEL Estimate Expected Life	IEL Estimate Annual Cost	Conservative Estimate Expected Life	Conservative Estimate Annual Cost
GRADE ONE						
Modules	3,200	$ 96.00	2	$ 48.00	2*	$ 52.80
Other Mat.	11,690	350.70	5	70.14	4	87.68
Total	14,890	446.70		118.14		140.48
GRADE TWO						
Modules	3,200	96.00	2	48.00	2*	52.80
Other Mat.	12,890	386.70	5	77.34	4	96.68
Total	16,090	482.70		125.34		149.48
GRADE THREE (I)						
Modules	1,600	48.00	2	24.00	2*	26.40
Other Mat.	7,045	211.35	5	42.27	4	52.84
Total	8,645	259.35		66.27		79.24
GRADE THREE (II)						
All Materials	9,386	281.58	5	56.32	4	70.40
GRADE FOUR						
All Materials	22,332	669.96	5	133.99	4	167.49
GRADE FIVE						
All Materials	22,332	669.96	5	133.99	4	167.49
GRADE SIX						
All Materials	22,332	669.96	5	133.99	4	167.49
GRAND TOTAL	116,007	$3,480.21		$768.04		$942.07

*A ten percent increase in wastage over that assumed in the IEL estimate.

Source: Report No. 1 - "Cost Issues in the Liberian IEL Project"

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Report No. 1 of the IEL Cost Analysis Project identified several problems in the adaptation of the IEL curricular technology to the Liberian elementary school system. One of these problems was the quantity of materials used and the burden this factor imposed on the management skills of the untrained teachers. A second problem was the requirement for extensive supervision of teachers during the IEL process. The third and most critical problem was the rigidity of IEL packaging of materials such that small classes of six to ten required the same quantity of materials as large classes of fifty to sixty students.

The reason for the severity of the packaging problem is that, once beyond Grade One, the size of classes in most Liberian schools decreases dramatically. Grade Five and Six classes often do not exceed ten or fifteen students. The result is that the per-student costs of IEL are greatest for the size classes most common in the Liberian system. Textbook costs, on the other hand, are fixed per student regardless of the number of students in a class. This makes textbook use more adaptable to small-size classes in terms of cost.

Table Two indicates the present estimate of relative annual IEL materials and textbook costs per student by grade level and class size. The textbook costs are based upon the Mark Carroll report of March 1981 on expenses required to supply a full set of texts for an individual student at each grade level and assume a three-year textbook life. His estimates were:

Grade One	$28.15
Grade Two	32.65
Grade Three	32.20
Grade Four	28.25
Grade Five	34.95
Grade Six	27.05

TABLE TWO

ESTIMATED RELATIVE ANNUAL PER-STUDENT COSTS OF INSTRUCTIONAL MATERIALS

IEL versus Textbook Requirements
by Grade Level and Class Size

Grade Level and Instructional Material	Number of Students in Class		
	20	40	60
GRADE ONE			
IEL	$ 5.91	$ 2.95	$ 1.97
Textbook (A)	9.38	9.38	9.38
Textbook (B)	4.69	4.69	4.69
Textbook (C)	2.35	2.35	2.35
GRADE TWO			
IEL	6.27	3.13	2.09
Textbook (A)	10.88	10.88	10.88
Textbook (B)	5.44	5.44	5.44
Textbook (C)	2.72	2.72	2.72
GRADE THREE			
IEL	6.13	3.07	2.04
Textbook (A)	10.73	10.73	10.73
Textbook (B)	5.37	5.37	5.37
Textbook (C)	2.68	2.68	2.68
GRADE FOUR			
IEL	6.70	3.35	2.23
Textbook (A)	9.42	9.42	9.42
Textbook (B)	4.71	4.71	4.71
Textbook (C)	2.36	2.36	2.36
GRADE FIVE			
IEL	6.70	3.35	2.23
Textbook (A)	11.65	11.65	11.65
Textbook (B)	5.83	5.83	5.83
Textbook (C)	2.91	2.91	2.91
GRADE SIX			
IEL	6.70	3.35	2.23
Textbook (A)	9.02	9.02	9.02
Textbook (B)	4.51	4.51	4.51
Textbook (C)	2.26	2.26	2.26

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The prices used are those for retail purchase at the Government Bookstore in Monrovia. The three alternative estimates used in Table Two are based on the following assumptions:

Textbook (A) - Assumes current costs of textbooks and one textbook for each child

Textbook (B) - Assumes reduced price (50%) of textbooks (from the IBRD Fourth Education Project materials component) and one textbook for each child

Textbook (C) - Identical to Textbook (B), but assumes students share books at rate of one textbook for every two children.

As indicated in Table Two, the IEL materials are always less expensive than the traditionally priced textbooks and are less expensive than the reduced price textbooks for the middle and larger class sizes. Only in the very largest classes, however, would the IEL materials be less expensive than the Textbook (C) alternative.

Table Three presents Table Two data which have been updated to reflect alternative packaging arrangements of IEL materials so as to create greater flexibility of materials requirements to size of class (See Report No. 2 of the IEL Cost Analysis Project). The "IEL Alternative" row in Table Three reflects the reduced costs at lower class sizes which repackaging allows. The IEL alternative is much more economical at the lower class sizes than is

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TABLE THREE

ESTIMATED RELATIVE ANNUAL PER-STUDENT COSTS OF INSTRUCTIONAL MATERIALS

IEL Versus Textbook Requirements
(By Grade Level and Class Size)

Grade Level and Instructional Material	Number of Students in Class		
	20	40	60
GRADE ONE			
IEL - Original	$ 5.91	$ 2.95	$ 1.97*
IEL - Alternative	4.13	2.51	1.97*
Textbook (A)	9.38	9.38	9.38
Textbook (B)	4.69	4.69	4.69
Textbook (C)	2.35*	2.35*	2.35
GRADE TWO			
IEL - Original	6.27	3.13	2.09*
IEL - Alternative	4.25	2.63*	2.09*
Textbook (A)	10.88	10.88	10.88
Textbook (B)	5.44	5.44	5.44
Textbook (C)	2.72*	2.72	2.72
GRADE THREE			
IEL - Original	6.13	3.07	2.04*
IEL - Alternative	3.[illegible]6	2.19*	2.04*
Textbook (A)	10.73	10.73	10.73
Textbook (B)	5.37	5.37	5.37
Textbook (C)	2.68*	2.68	2.68

*Least expensive alternative for grade level and size combination.

(Continued on Following Page)

TABLE THREE (Continued)

Grade Level and Instructional Material	Number of Students in Class		
	20	40	60
GRADE FOUR			
IEL - Original	6.70	3.35	2.23*
IEL - Alternative	2.02*	1.95*	2.23*
Textbook (A)	9.42	9.42	9.42
Textbook (B)	4.71	4.71	4.71
Textbook (C)	2.36	2.36	2.36
GRADE FIVE			
IEL - Original	6.70	3.35	2.23*
IEL - Alternative	2.02*	1.95*	2.23*
Textbook (A)	11.65	11.65	11.65
Textbook (B)	5.83	5.83	5.83
Textbook (C)	2.91	2.91	2.91
GRADE SIX			
IEL - Original	6.70	3.35	2.23*
IEL - Alternative	2.02*	1.95*	2.23*
Textbook (A)	9.02	9.02	9.02
Textbook (B)	4.51	4.51	4.51
Textbook (C)	2.26	2.26	2.26

*Least expensive alternative for grade level and size combination.

the original IEL package and greatly enhances cost comparability between IEL and the textbook-based systems.

In the analysis which follows, only the materials component of IEL will be used as the measure of current cost differences between IEL and the OC and SQ schools. The justification for this procedure is that the other costs associated with IEL--teacher training, equipment, and supervision--represent investments in the dissemination of IEL rather than in its ongoing day-to-day operation. These dissemination costs are of legitimate concern in terms of the decision of whether to disseminate IEL, but they are not appropriate costs to include in the evaluation of relative cost-effectiveness of the curricular technology. (Report No. 4 of the IEL Cost Analysis Project will analyze the dissemination costs of IEL in terms both of their effect on the fiscal absorptive capacity of the Ministry of Education and their sensitivity to various proposed means of phasing in the IEL system.)

The materials costs to be used in the combined cost/achievement analysis will be the IEL original estimate and the Textbook (B) estimate, since these appear to represent the most probable short-run costs of the two systems. In each case, it is assumed that the SQ schools operate with no current materials expenses relative to IEL and OC.

The achievement data used are based upon tests designed by Dr. Klaus Galda in cooperation with the Monrovia staff of the West African Examinations Council (WAEC). The tests, by subject for each grade level from Grade One to Four, were keyed to the Ministry of Education's curriculum coverage for that grade. The tests were administered in November 1982, about two weeks before the end of the school year.

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Several problems arose in terms of test administration. Galda cites the following:

(1) Inadequate training of test administrators;
(2) Difficulty in use of tape recorded instructions;
(3) Incorrect packaging of test materials;
(4) Problems of English language comprehension on the part of the students;
(5) A failure to collect the data on characteristics of the school and the students; and
(6) Lost or misplaced examinations for some students.

Even so, Galda notes that, "From the evidence I have seen it does not seem that in general the evaluation has been in any serious sense invalidated by the irregularities...."

However, since the time the Galda report was written, it has been discovered that use of the IEL instructional materials in the IEL schools has followed a pattern not envisioned at the time the achievement tests were designed. Table Four presents a recent report from IEL staff concerning module utilization in the five IEL schools for 1982. Part I indicates the total number of modules available for each grade level. (All Grade One and Two modules are for PT and all Grade Four modules are for PL.) Part II indicates the average number of modules completed in the IEL schools in 1982, and Part III presents detailed data, by school, on module completion by subject.

The difficulty does not lie primarily in the inability of IEL teachers and students to cover all of the year's material in the given year. External observers have already noted the unrealistic expectations of the IEL system, especially given the actual number of days that an elementary school is likely to be in session during a given year. This is a problem--much like

TABLE FOUR

1982 MODULE COMPLETION REPORT

IEL SYSTEMS SCHOOLS

May 11, 1983

	Grade			
	1	2	3	4
I. Target:				
Mathematics	1 - 10	11 - 20	21 - 25 PT 26 - 37 PL	38 - 62
Reading	1 - 10	11 - 20	21 - 25 PT 26 - 37 PL	38 - 62
Language	1 - 10	11 - 20	21 - 25 PT 26 - 37 PL	38 - 62
Social Studies	1 - 5	6 - 10	11 - 15 PT 16 - 25 PL	26 - 50
Science	1 - 5	6 - 10	11 - 25 PL	26 - 50
II. Average Number of Modules Completed--All Systems Schools:				
Mathematics	5.20	9.00	17.80	30.75
Reading	5.00	9.25	17.80	31.30
Language	5.00	9.60	19.20	29.50
Social Studies	3.00	4.50	9.00	17.00
Science	2.75	4.00	9.25	19.25

(Continued on Following Page)

a1

TABLE FOUR (Continued)

	Grade			
	1	2	3	4
III. Module Completion by School:				
Dorothy Cooper School				
Mathematics	7	10	17	25*
Reading	6	9	17	-
Language	5	10	17	25*
Social Studies	5	8*	-	12*
Science	4	8*	9	20
Frelala School				
Mathematics	5	9	17	31
Reading	5	6*	15	34
Language	5	10	18	30
Social Studies	2	5	8	19
Science	2	4	9	20
Doloboi School				
Mathematics	5	9	18	30
Reading	4	8	21	30
Language	5	9	21	29
Social Studies	-	3*	9	16
Science	-	3*	9	19
S. S. Collins School				
Mathematics	4	7	19	32
Reading	5	10	18	29
Language	3*	9	20	30
Social Studies	1	4*	10	18
Science	2	4*	10	20
J. S. Milton School				
Mathematics	5	10	18	30
Reading	5	10	18	30
Language	5	10	20	29
Social Studies	2	4	8*	15
Science	3	4	9*	-

*Data available not sufficiently current; not included in average in Part II.

that of materials inflexibility--that the IEL staff must address if the IEL system is to be adapted to the Liberian environment.

The problematical issue for this analysis, however, is not that of the amount of coverage, but of the sequence of coverage. The numbers in Table Four indicate that the average student beyond Grade One never studied in a module that covered the curriculum for his or her current grade level. An examination of the school module completion data reveals that in only a few isolated instances did <u>any child</u> study modules from the appropriate grade level.

These figures, if accurately reflective of IEL procedures, raise serious doubts about the meaningfulness of the achievement results. Because the tests are linked to the curriculum of a certain grade level, IEL students were asked to respond to questions based on instructional topics to which they were either never exposed or not exposed at the anticipated level of progress. Rather than the achievement test measuring the ability of students to learn from the IEL material, they measured this ability <u>plus</u> the degree of curriculum overlap from one grade to the next.

To explain, it is common to have a great deal of content overlap from one year to the next, especially in mathematics and language arts. The degree of this overlap varies from curriculum to curriculum, but a third grade student, for example, would not be expected to fail a fourth grade examination totally. One would expect, however, that the higher the grade level of the examination, the poorer the third grader would do. Thus, in the achievement test evaluation, IEL students may have learned exceedingly well the material in the modules they covered. (The third grade results, as will

be discussed below, tend to confirm this.) However, IEL students are placed under an increasing disadvantage whenever the curriculum overlap between what they have studied and what the tests cover is reduced.

Two issues need to be resolved in terms of the question of IEL module completion rates. First, is the official Ministry of Education curriculum too ambitious for the time and other resources available at the elementary school level? Second, can the quantity and sequencing of IEL materials be modified so as to allow for greater coverage of the curriculum without unduly sacrificing the advantages of the present system of sequential learning? A third and separate question relates directly to the interpretation of the relative scores by IEL, SQ, and OC: To what extent did the SQ and OC schools cover the specific grade level curriculum material upon which the achievement tests were based?

Table Five presents a summary of the post-test scores, by grade level and subject, for each of the three school types. The interest in terms of cost effectiveness is only in those results which can be shown to be significantly different from what would occur in the SQ schools. In the parlance of experimental design, the SQ schools are the control group; they represent the level of achievement that would result if the government did nothing to change the elementary education system. The OC schools serve as an experimental group which was supposed to represent an enriched form of the SQ school. As was noted earlier, for the 1982 year from which these tests results are taken, the OC schools did not have significantly different resource characteristics than the SQ schools. Finally, the IEL schools represent the second experimental group which differed from the SQ schools in

TABLE FIVE

POST-TEST SCORES

BY GRADE, SUBJECT, AND SCHOOL TYPE

Grade Subject School Type	Mean % Correct	Standard Deviation
GRADE ONE - English		
SQ	44.0	16.8
OC	63.0***	27.0
IEL	46.2	19.0
GRADE ONE - Mathematics		
SQ	78.5	19.7
OC	79.1	21.2
IEL	64.4***	26.1
GRADE TWO - English		
SQ	37.3	15.9
OC	58.2***	25.3
IEL	48.9***	14.9
GRADE TWO - Mathematics		
SQ	51.6	19.3
OC	60.5***	18.7
IEL	55.9*	17.2
GRADE THREE - English		
SQ	53.0	17.4
OC	55.9	17.9
IEL	60.5***	17.1
GRADE THREE - Mathematics		
SQ	52.3	15.5
OC	51.9	17.5
IEL	58.0**	17.7

Note: OC and IEL school results are identified as significantly different from those of the SQ schools according to the following denotation:

*significant at .05 level
**significant at .01 level
***significant at .001 level

.01

TABLE FIVE (Continued)

Grade Subject School Type	Mean % Correct	Standard Deviation
GRADE THREE - Science		
SQ	42.9	11.6
OC	54.8***	16.0
IEL	55.2***	12.5
GRADE THREE - Social Studies		
SQ	47.7	12.7
OC	57.5***	13.9
IEL	50.3	13.9
GRADE FOUR - English		
SQ	51.2	18.4
OC	56.6	25.3
IEL	48.3	19.0
GRADE FOUR - Mathematics		
SQ	55.4	19.5
OC	59.4	21.9
IEL	40.4***	15.7
GRADE FOUR - Science		
SQ	49.6	16.1
OC	62.5***	18.2
IEL	44.0*	16.8
GRADE FOUR - Social Studies		
SQ	45.9	11.7
OC	58.7***	19.9
IEL	37.3***	13.2

Note: OC and IEL school results are identified as significantly different from those of the SQ schools according to the following denotation:

*significant at .05 level
**significant at .01 level
***significant at .001 level

terms of the type and availability of materials, teacher training, and supervision.

The data presented here are based on the mean percent of correct reponses of all students in each type of school on each of the achievement tests given. Galda has also reported the achievement tests results on the basis of the means of the school means. He has noted the weakness in the latter approach (a small school's average score counts the same as a large school's average score), but feels it is still useful data. For the purposes here, it is important to restrict the analysis to statistically significant results. With only five schools of each type, it is extremely unlikely that any but the most disparate results would be shown to be significantly different from zero in the school-based analysis. In fact, only three grade-level tests were shown to represent significant mean achievement differences in the school-level analysis; all were for IEL schools. This was for the Grade Two English (+13.6), Grade Three English (+13.6), and Grade Three Science (+10.3).

Returning to Table Five, the relative achievement of the three school types can be assessed in terms of grade level and subject. In Grade One, the OC schools scored significantly higher than the SQ schools in English, while the IEL schools are significantly lower in Mathematics. Both sets of scores suggest a disappointing result for the IEL system.

In Grade Two, IEL and OC schools are both higher than the SQ schools in English and in Mathematics. The OC schools, however, also scored significantly higher than the IEL schools in both subjects.

It is in Grade Three that the most encouraging results are found for IEL. The IEL system schools are significantly higher than either of the SQ or OC types of school in both English and Mathematics. This pattern is modified in the Science test results, where IEL and OC are superior to SQ but not significantly different from each other. The Social Studies results show IEL schools once again equal to the SQ and lower than the OC scores.

The Grade Four results reveal no statistically significant differences in English, but IEL is lower than the other two school types in Mathematics. This pattern of IEL disappointment continues in the Science and Social Science results.

COST AND ACHIEVEMENT ANALYSIS

Both the length of introduction to the analysis in this report, and the brevity of the analysis itself, are traceable to the same cause: the suspect and limited nature of the achievement data for the purposes of cost-effectiveness evaluation. The achievement data may be considered as inappropriate for a variety of reasons, including the original selection criteria for OC and SQ, the sample size, the problem of test administration, the lack of concomitant data on teacher and student characteristics, and the lack of instuctional process data (e.g., number of days actually taught and subject matter covered).

What is known about the data is that for the IEL schools, at least, the achievement tests did not correspond to the subject matter covered in school during that year. It is impossible to know, however, what differences, other

than in instructional technology, existed among the schools in the study and, therefore, could have created a bias in the achievement results. For example, one school, the David Fejue School, accounts for much of the difference that exists between the OC schools and the other school types. The outstanding results for this school, if one can accept the evidence of the achievement tests, may be due to outstanding teachers, highly motivated students, or a variety of other unknown influences. In a small sample such as exists in this evaluation design, a single outlier in the distribution can have a dramatic effect on the average scores for the group.

If Galda had combined the SQ and OC schools, as appears justified by what is known of their minor differences in materials provision, teacher training, and supervision, the result would have been to reduce the effect of the single outstandingly good or bad school on the overall group mean. Table Six presents the reconstructed group means for the combined SQ/OC control population and indicates the net difference in mean scores attained by the IEL system schools.

In summary, Table Six indicate serious weaknesses in achievement in IEL classrooms at Grades One and Four, no significant difference in achievement in IEL and non-IEL classrooms at Grade Two, and significant strengths in IEL performance in every subject in Grade Three except for Social Studies where no significant difference exists. While still not indicative of a consistent pattern, the results in Table Six are substantially less anomalous than those indicated in Table Five. This may be because the combined SQ/OC grouping more accurately resembles the proper experimental design categorization or

TABLE SIX

MEAN ACHIEVEMENT DIFFERENCES

IEL VERSUS COMBINED SQ/OC CONTROL GROUP

Grade Subject	SQ/OC Mean Score (Percent Correct)	IEL Mean Score (Percent Correct)	IEL Advantage
GRADE ONE			
English	54.5	46.2	-8.3*
Mathematics	78.8	68.4	-10.4*
GRADE TWO			
English	49.8	48.9	-0.9
Mathematics	56.5	55.9	-0.6
GRADE THREE			
English	54.7	60.5	+5.8*
Mathematics	52.1	58.0	+5.9*
Science	49.9	55.2	+5.3
Social Studies	53.3	50.3	-3.0
GRADE FOUR			
English	54.2	48.3	-5.9*
Mathematics	57.6	40.4	-17.2*
Science	56.9	44.0	-12.9*
Social Studies	53.3	37.3	-16.0*

*Indicates significance level of .05 or above.

could be a fortuitous and spurious mathematical result. Assuming the former, one can hypothesize as to why the pattern revealed in Table Six could occur.

The Grade One achievement problems are undoubtedly due in part (but there is no way to know how much) to the difficulty the students would face in adapting to the IEL curricular program. IEL's greater complexity suggests a need for a period of adjustment which may be expected to be greater than that necessary for the student in the traditional SQ/OC classroom. In Grade Two these adaptations appear to have been accomplished sufficiently that IEL and non-IEL achievement are equal. And finally, by Grade Three, even with the disadvantage noted earlier for IEL students because of still working at Grade Two level modules, significant benefits appear.

The disappointing results for Grade Four are traceable to at least two causes. The first is the non-exposure to the Grade Four curriculum, an especially serious handicap in the non-English subjects. The second is the fact that this was the first year of IEL instruction, and therefore the teachers were involved in IEL instruction for the first time. It was also the first year the Grade Four modules were used outside the IEL Laboratory School, but this is hardly relevant if few children ever advanced to these module levels.

Less benign interpretations could be made of the data in Table Six. However, the fairest conclusion is that the data provides both comfort and confusion for those who are supportive of the IEL system of instruction.

In Table Seven, the analysis of IEL is expanded to look simultaneously at the cost and the achievement differences. All cost and achievement differences are given <u>relative</u> to the <u>SQ</u> costs and scores. In addition, the achievement difference is divided into changes in mean scores and changes in

TABLE SEVEN

COST AND ACHIEVEMENT DIFFERENCES

BY GRADE, SCHOOL TYPE, AND SUBJECT

Grade School Type	Cost Difference[a] (Per Student)	English		Mathematics		Science		Social Studies	
		MD	SDD	MD	SDD	MD	SDD	MD	SDD
GRADE ONE									
OC	(b)	+19.0	+10.2	n.s.	n.s.	-	-	-	-
IEL	2.46	n.s.	n.s.	-10.1	+6.4	-	-	-	-
GRADE TWO									
OC	(b)	+20.9	+ 9.4	+ 8.9	-0.6	-	-	-	-
IEL	2.46	+11.6	- 1.0	+ 4.3	-2.1	-	-	-	-
GRADE THREE									
OC	(b)	n.s.	n.s.	n.s.	n.s.	+11.9	+4.4	+ 9.8	+1.2
IEL	3.95	+ 7.5	- 0.3	+ 5.7	+2.2	+12.3	+0.9	n.s.	n.s.
GRADE FOUR									
OC	(b)	n.s.	n.s.	n.s.	n.s.	+12.9	+2.1	+12.8	+8.2
IEL	5.36	n.s.	n.s.	-15.0	-3.8	- 5.6	+0.7	- 8.6	+1.5

MD = Mean Difference

SDD = Standard Deviation Difference

(a) = IEL costs were determined by dividing total materials cost by the average size of IEL classes.

(b) = No cost difference is shown for OC schools, as textbooks were not provided for 1982.

the standard deviation. The latter measure can serve as an indicator of whether the changes in achievement are gained at the expense of increased inequality in achievement among the students. A purported advantage of the IEL system is an ability to increase achievement without the substantial increases in inequality commonly found in the traditional classroom.

For example, in Grade Two the OC schools' advantages in English are substantial, but so is the standard deviation. This means that the increase in average achievement of 20.9 points over the SQ scores was achieved not through a general increase but through the production of a smaller number of very high scores. The IEL increase, while less (+11.6 points), was achieved with less disparity in results than was the case for the SQ schools or the OC schools.

In every case but one in Table Six, the OC advantages in test scores were concomitant with a larger standard deviation than existed in the SQ schools. In contrast, in three of the six cells in which IEL shows a test score advantage over the SQ schools, there is a decline in the relative standard deviation. Too much should not be made of these relationships, given the earlier warnings concerning the problems of interpretation of the achievement data; but no final decision on the IEL system should be made simply on the basis of mean scores. If the interest is in the total distribution of achievement, the IEL instructional approach may have important advantages which should not be overlooked by an excessive concentration on differences in mean achievement levels.

Can a final judgment be made on the value of the IEL system from these results? It would seem not. A positive decision for IEL dissemination is

not justified even when the data are given the most favorable structure and interpretation. There are simply too many questions which remain unanswered concerning the relative efficacy of the IEL instructional system. However, there is enough encouragement in these results to argue against a negative decision as well. The IEL system continues to indicate a potential for relatively economical costs when compared to the textbook alternative. This economy would be reinforced if IEL staff would take more seriously the suggestions for reductions in module numbers and the quantity of related materials and the need to seek flexibility in adaptation to smaller classes.

The solution to this decision-making impasse cannot be simply to recommend further analysis. Steps must be taken to assure that the next evaluation will lead to complete and reliable data and that these data will permit conclusive decision making. No evaluation process can answer all questions, but the research design can control for the most important considerations. Therefore, the concluding section of this paper will discuss the design factors which must be incorporated into the 1983 IEL evaluation so that a final judgment on cost efficiency will be possible by Spring 1984.

SUMMARY AND RECOMMENDATION

In terms of cost, four major conclusions may be made in regard to the IEL system:

(1) While obviously more expensive than the present SQ-type school, the IEL system of instruction should be no more costly, at class

sizes of approximately forty or more students, than would be the most probable form of textbook-based system (Textbook alternative "B" shown in Table Two).

(2) At class sizes below forty students, the IEL system will be increasingly expensive relative to the textbook alternative, and will be more expensive than textbook use at class sizes below the following levels:

Grade One	25
Grade Two	23
Grade Three	23
Grade Four	28
Grade Five	23
Grade Six	30

(3) Similarly, at smaller class sizes, the IEL system would be more expensive to disseminate even if one assumes, as is unlikely, that teacher training, supervision, distribution, and dissemination costs are no more expensive for the IEL than for the textbook dissemination system.

(4) Several potential internal economies remain to be exploited in the IEL system in terms of the total quantity of materials required and usable, and in terms of the organization of materials for use in small classes and/or with teachers who have multi-classroom, multi-subject responsibilities.

In terms of IEL effectiveness, the conclusions which may be drawn from the recent achievement evaluation are less certain. The IEL system remains intuitively attractive because of its ability to structure the use of teacher and student time. Also, its systematic progression through the subject matter of the curriculum should promote greater understanding and retention. The achievement results, however, are largely disappointing, except at Grade

Three, even when IEL is compared to the combined SQ/OC control population. The low scores of IEL students at Grades One and Four may be due to delayed student and teacher adaptation, respectively; but the data available are inadequate to confirm this. The Grade Two results, where no significant differences in achievement were found, were hardly more encouraging, given the additional costs of the IEL program.

The residual uncertainty over IEL efficacy and the ability of the system to justify its costs cannot be allowed to become a permanent condition. The 1983 evaluation design should allow for much greater control of non-curricular technology differences among the school populations. While the expansion to forty-five schools (fifteen of each type) should have reduced the small-sample-size problem, it did not do so because of problems of non-standardization which will be discussed below. The new schools do, however, pose a methodological problem. The IEL population will consist of five schools where students have used IEL materials for one year or more (except, of course, at Grade One) and ten schools where students will be using the IEL system for the first time at all grades. It will be necessary to divide the IEL group into two parts, both for comparison with one another and for comparison separately with the SQ and OC populations.

The major areas of attention for research design for the 1983 evaluation are:

(1) Pretesting requirements;
(2) Improved data on student characteristics;
(3) Improved data on teacher characteristics; and
(4) Measures of curriculum coverage.

Each will be detailed below.

(1) Pretesting Requirements. The attempts in the Galda report to conduct a longitudinal analysis of IEL and non-IEL learning are highly suspect given, as Galda makes quite clear, the change in the nature of the test population. Because of attrition, repetition, and absenteeism (none of which is necessarily random), there is little chance that the students taking a post-test in one year are the same students who took an earlier pretest or post-test at the same school. Galda notes that the overlap could be less than 50 percent.

However, without pretest data, it is impossible to ascertain the value added of a year of instruction within any of the three school types, or to control for existing differences in prior achievement among schools. Students in all grades in the thirty new schools added to the evaluation in 1983, and in the first grade in the original fifteen schools, have been administered pretests designed by the IEL project staff. If the reliability of these tests can be accepted, the residual problem is the failure to test the second, third, and fourth grade students at the original fifteen schools. Thus, there will be no opportunity to control for ability differences in any analysis which includes the population of the five IEL, five OC, and five SQ schools that were the cases for the 1982 evaluation.

In consultation with the evaluation specialist, Dr. Galda, it has been decided to recommend that the previous year's post-test scores be used as controls on prior achievement for the second, third, and fourth grade students at the original fifteen schools. All students in the forty-five 1983 evaluation schools are being assigned identification numbers. It will be necessary to have the present students (except those in first grade) in

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the original IEL, OC, and SQ schools matched with the post-test scores from 1982. This can be done through matching of names and test scores and then recording all data in terms of the new identification numbers. The use of identification numbers will allow much more detailed student-level analysis than was practical in the previous year's evaluation.

The result will be an experimental design in which the following analysis can be made with control for prior achievement:

(a) New IEL versus new OC and SQ schools, by grade level and subject;

(b) Old IEL versus old OC and SQ schools, by grade level and subject;

(c) Old and new IEL combined versus old and and new OC and SQ schools, for Grade One only, in English and Mathematics; and

(d) Old IEL versus new IEL, Grade One only, for English and Mathematics.

Because the pretest and the post-test control variables for prior achievement are not equivalent, it is not possible to compare students in the second, third, and fourth grade classes in the original set of fifteen IEL, OC, and SQ schools with the students in the new set of thirty IEL, OC, and SQ schools. This could be done if one decided to delete the control on prior achievement, but the result would be to produce the same type of uncertainty concerning causality of achievement which plagued the 1982 evaluation.

The purpose of the comparisons between IEL and the two control populations (Items (a), (b), and (c) above) is to establish the relative effectiveness of the IEL curricular strategy versus the traditional alterna-

tives. Comparison (d), between old and new IEL classrooms, will test the hypothesis that teacher familiarity with IEL materials increases the overall instructional effectiveness. Unfortunately, another important hypothesis, that student familiarity with IEL materials also increases instructional effectiveness, cannot be tested except in the absence of a control on prior achievement. Since the second, third, and fourth graders at the five original IEL schools were not given pretests for 1983, but the ones at the ten new IEL schools were, there will be no comparable measure of prior achievement to control for when studying variation in 1983 achievement.

(2) Improved Data on Student Characteristics. It is vital that more adequate data be collected on student characteristics. With a lack of pretest equivalency, the collection of information on student (and teacher) characteristics is even more mandatory. All of the data should be coded so as to create a student-specific file of characteristics which can be linked to the teacher, curricular technology, and test results variables.

The main student characteristics needed are: age, sex, years in school, repeater status in present grade, and rate or days of absenteeism. For the IEL students, there should also be information on the years of previous IEL material use. Years of pre-Grade One schooling is an additional variable that may be considered, although the 1982 data did not indicate that it had a significantly differentiating effect.

(3) Improved Data on Teacher Characteristics. Because of the central role played by the teacher as the primary intervening variable between the curricular technology and the student, it is necessary that detailed information be collected so that achievement results are credited

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appropriately to the teacher and to the instructional approach. Even in the expanded sample of forty-five schools, a spurious correlation between technology and achievement could occur if highly motivated and able teachers are not randomly distributed among the three school types.

The most useful measure of teacher quality would be to have estimates of teacher verbal and mathematical ability. It has been suggested by Ministry of Education personnel that the teacher could be given the national 9th or 12th grade examinations which have verbal and mathematical components. Previous research on classroom effects have shown that these characteristics of teachers are the ones most often correlated significantly with student achievement.

Additional teacher data which would be valuable would include: age, sex, years of teaching experience, highest education level attained, possession of teacher training credentials, rate or days of absenteeism, single- or multi-grade-level responsibility, and class size. Teachers in the IEL schools should be identified in terms of years of IEL experience. All teacher data should be coded so as to be matchable to the specific students in the teacher's class.

A special problem in regard to matching teacher characteristics to student achievement is the practice of having subject-specialized teachers in the elementary school. Thus, one teacher may teach mathematics for two or more grade levels, while others will do the same for English, reading, etc. Thus, to match teacher to student is a more complicated process than where a single teacher is responsible for all subjects at a given grade level. For most schools, Grades One and Two are taught by a

single teacher; but, for Grades Three and Four, subject specialization is the common practice.

This pattern will require that the teacher survey identify teachers by grade level and subject taught. Where more than one class exists at a grade level, the survey will have to collect the names of all students in each teacher's classes. This will allow matching of the teacher's characteristics to the specific identification numbers of students in his or her classes.

A special problem exists in regard to the English achievement test. At certain schools, separate teachers have responsibility for reading, language arts, and spelling. In these cases, a combined teacher characteristic variable must be created. While simple enough to do mathematically, there are obvious methodological problems of interpreting the meaning of a variable based on an average of characteristics over such a small number of individuals. In any case, the inclusion of the teacher data, <u>especially that on math and verbal ability</u>, will greatly enhance the analyst's potential to interpret the results in terms of the relative effectiveness of the curricular alternatives.

(4) <u>Measures of Curriculum Coverage</u>. In an evaluation of alternative curricular technologies, it is absolutely essential that information be collected on how much of the curriculum was actually covered by a particular classroom of students. The importance of this information was highlighted in the current analysis because of the incongruence between IEL materials use and the national grade level curriculum. For the 1983 evaluation, it will be important to ascertain exactly what textbooks the OC

schools obtained and what amount of the material was covered. Because all OC schools did not receive all textbooks, it is necessary to incorporate into the final analysis a measure of curriculum coverage for each of the subject areas tested for on the achievement examination.

In addition to the above data requirements, two areas of research design remain to be addressed: the structure for data collection and the format of data analysis. Three major parties should be involved in the data collection. The primary responsibility for final design and overall implementation should rest with the external evaluator. The actual data collection responsibilities should be divided between IEL project staff and Ministry of Education personnel.

The IEL staff should be assigned the task of collecting data on student characteristics, teacher characteristics (except verbal and math test scores), IEL module use, and textbook availability and use in the non-IEL schools. The Ministry of Education, in cooperation with the WAEC, should be responsible for teacher verbal and math skill testing and for data on teacher and student absenteeism. The work of both groups should be coordinated so that all data is coded in a student-specific manner. Variables such as teacher characteristics and classroom curriculum coverage should be coded for matching to each student in the particular classroom.

The external consultant should be on site during the full period of data collection in November 1983 and again to monitor problems in the coding process. The analysis and description of results should be solely the responsibility of the external consultant, but provisions should be made for a full review of the evaluation draft by Ministry of Education, IEL, and

USAID personnel before the report is finalized. The external consultant should be in Liberia during the time of draft revision so the comments and suggestions of all parties can be incorporated, as appropriate, into the final draft.

The data collection recommended here will allow for more detailed analysis than the simple mean, standard deviation, frequency distribution, and contingency analysis to which the 1982 evaluation results are restricted. A simplified production function model of school results can be used to elicit the effect of the curricular technology under ceteris paribus (all other things equal) conditions. The function would take the form of

$$X = X\ (S,T,C,e)$$

where "S" represents a set of student characteristics, "T" a set of teacher characteristics, "C" a set of measures of the curriculum alternative and of the degree of coverage, and "e" represents an error term. The output "X" can be defined in terms similar to that used in the 1983 achievement results. An additive form of the production function would be most appropriate, given the level of data aggregation. A separate function would be estimated for each grade-level/subject combination.

This analysis, combined with updated IEL and textbook cost data (to the extent costs are anticipated to have changed), would provide the most complete evaluation of the IEL system's appropriateness for general dissemination. The full analysis, including review, should be completed by June 1984.

The recommended evaluation design may seem especially demanding; and, in terms of the 1982 design, it does represent a substantially more complex approach. There will also be concomitant increases in expense.

However, economizing on evaluation should never be assumed to imply doing the least expensive evaluation. Given the scale of Liberian government funds that would be involved in an IEL dissemination, and the potential effect of the change in curricular technology on the lives of students, it would be extremely short-sighted not to assure that the best possible data are collected within the limits of resource availability. Of course, cost effectiveness evaluation is subject to its own analysis in terms of costs and effects. The research design proposed here should prove to be a good investment and allow for a conclusive decision concerning the IEL system's future status.

V

Cost Issues in the Dissemination of the Liberian Improved Efficiency of Learning (IEL) Project

Report No. 4 of the IEL Cost Analysis Project

Douglas M. Windham

June 1983

COST ISSUES IN THE DISSEMINATION

OF THE LIBERIAN

IMPROVED EFFICIENCY OF LEARNING

(IEL) PROJECT

Report No. 4

INTRODUCTION

Two major cost issues exist in terms of the ultimate evaluation of the IEL instructional program for use in the general Liberian elementary education system. The first is the relative cost-effectiveness of the IEL curricular technology in actual classroom use, as opposed to the traditional teacher-based system or the traditional system supplemented by improved teacher training and greater availability of textbooks. Report No. 3 of the IEL Cost Analysis Project reviewed the current data available on relative cost-effectiveness of IEL. While some of the data were encouraging for the IEL methodology, no conclusive findings were justified given the problems with the 1982 achievement data and the inconsistent results for IEL across grade levels and subjects.

The second major cost issue, and the central concern of this report, is the cost of IEL dissemination, i.e., the costs incurred by the initial implementation of IEL outside the evaluation experiment schools. These costs are of a different nature than the recurrent costs (primarily of materials

replacement) which will be incurred in the day-to-day operation of schools that adopt the IEL system. The dissemination costs represent an "investment" related to the one-time expenditure on pre-dissemination teacher training, initial supervision of IEL implementation, and provision of the original set of IEL materials and equipment. (This last cost will include both printing and delivery expenses.)

The costing of these various activities is made difficult by the fact that no final IEL teacher training, supervision, or dissemination plan is yet in existence. Even the provisional plan to disseminate IEL to a set of ten schools in each of the nine counties of Liberia has now been suspended, and the actual dissemination strategy will be dependent upon the results of the 1983 evaluation. This report will conclude with a brief recommendation on how the dissemination planning process should proceed in the interim until the next evaluation cycle is complete.

The immediate contribution of this report will be to examine some of the costs and non-cost constraints which will limit any dissemination program. Cost estimates will be provided for the expense of a hypothetical program of IEL dissemination to the government elementary school system. In addition, the cost data will be presented so as to allow for a recosting of alternative systems of partial or complete dissemination.

This report will also provide separate dissemination cost estimates by grade level and by county. As it is extremely unlikely that a simultaneous nationwide dissemination of IEL will occur, these detailed cost estimates will allow for a costing based upon any combination of grade level and regional distribution.

NON-COST CONSTRAINTS TO DISSEMINATION

As noted above, there are three activities which, regardless of cost, will be constraints on the timing within which IEL dissemination can be achieved. The first is the printing capacity of the IEL modules/materials production system. Assuming continued use of photocopying as the sole means of materials reproduction, the use of the present IEL equipment, even in conjunction with support from the private facilities provided by SINIMAX, Inc., establishes a limit on how much IEL material can be published in a given amount of time. Equipment failure and the uncertainty of electrical power create further constraints on the probable production capacity.

Some conservative lead time will have to be allowed for IEL production so as to avoid the frequent delays in materials provision which has characterized the IEL system in the experimental schools. In addition to production timing, dissemination planners must also allow for adequate delivery time. Presently, IEL production is located in Monrovia (as is the SINIMAX facility). All distribution of materials must originate at this locus. The more distant the schools that are to receive IEL materials, and/or the more indirect the transportation linkages, the more time that will be required for actual distribution.

As great a constraint as the printing and distribution process will represent, it probably will be less restrictive than will be the need for pre-dissemination teacher training and for initial supervision of IEL implementation. The capacity of the various potential sources of teacher training

(University of Liberia, Cuttington University College, Kakata Rural Teacher Training Institute, and Zorzor Rural Teacher Training Institute) is quite limited for all but a very long-term dissemination plan. At this time only the Cuttington University College personnel have worked with the IEL experimental project and then only to prepare traditional and not IEL teachers. The recent teacher training programs involved only slightly more than one hundred teachers. Pre-dissemination teacher training would have to be on a much larger scale. Given the dramatic change in teaching style and technique which the IEL technology requires of the instructor, it would be unwise to envision expansion of the IEL system to schools which have not had the benefit of teacher training in the use of IEL materials.

The IEL project staff are currently engaged with Ministry of Education personnel in the implementation of an inspection/supervision system for the SQ and OC schools. These same personnel need to be introduced to the requirements of supervision which will be a part of the initial IEL dissemination process. IEL staff should design an implementation supervision format for use by Ministry of Education inspectorate staff. There is also a need to analyze the extent to which the supervisory requirements themselves will exert a constraint on the rate of IEL implementation. The greater the skills and training required to supervise IEL, the fewer individuals there will be who are qualified to do the work. This is an important issue, and steps should be taken now to prepare for the training of supervisors in various parts of Liberia so that dissemination will not be restricted to the geographical area in which the project is now located.

CLASS-SIZE CONSTRAINTS TO DISSEMINATION

A major finding of the Cost Analysis Project has been the relationship between class size and the relative costliness of the IEL system compared to the textbooks-based instructional alternative. The IEL system is more expensive per student at class sizes below twenty students and only becomes less expensive for class sizes above forty students. As was pointed out in Report No. 1, the reality of the Liberian system is that most elementary classes beyond grade one are of less than optimal size for IEL instruction. IEL curriculum design staff have been encouraged to pursue the dual options of materials reduction and materials repackaging. Given the information provided in Report No. 3, that classes are covering only from fifty to seventy percent of the module schedule, the first option of materials reduction is even more mandatory. Can the content of IEL modules and support materials be melded so that classes cover a full year's curriculum in one year? If so, the result would have financial benefits as well because of the reduced number of modules, review booklets, and other materials that would be required.

Repackaging recommendations have met resistance from the IEL staff. While the curriculum specialists must be the final arbiters on these matters, it is important that they realize that suggestions for redesign are not attacks on the IEL system but are attempts to increase the real chances for IEL to be shown to be economically viable. Given the fiscal limitations on the Government of Liberia and the lack of current effectiveness data that

show a consistent learning advantage for IEL students, these economizing issues are of increased importance.

For the present analysis, the existing fit of IEL to class size will be used. To understand the nature and scope of the problem of fit, it is necessary only to review the data in Table One. This table presents the distribution of class sizes, by county and grade. Monrovia City is listed separately; thus the Montserrado County data is exclusive of Monrovia City schools. This geographical listing will be maintained throughout the remainder of this report.

The data in Table One (upon which the later analysis is based) comes from the 1981 school survey of the Ministry of Education. Enrollments were collected by grade level (including Kindergarten and pre-Grade One classes) for schools having any elementary school classes. Thus, some junior high schools that have fifth and sixth grade classes are included in the survey data.

As would be expected, the largest schools are located in those areas where cities or large towns exist (Monrovia, Lofa County, Bong County, Nimba County, and Maryland County). This same finding is confirmed if one examines the school list of the original census. This relationship between urbanity, large size, and IEL fit poses a problem for the IEL project rationale, since IEL was originally designed as a curricular support system to aid the rural schools and especially those where poor teacher quality posed a barrier to student achievement. However, these data indicate that the IEL system has the greatest relative cost advantage only in those urban or large town schools where teacher quality, although perhaps still low by an absolute

TABLE ONE

SIZE DISTRIBUTION OF CLASSES, ALL SCHOOLS, 1981

BY GEOGRAPHIC DESIGNATION AND GRADE LEVEL

County/City Grade Level No. of Schools	Size Distribution				
	1-20	21-40	41-60	61-100	101+
Monrovia City					
Grade 1 (104)	34	24	16	14	16
2 (104)	44	28	10	10	12
3 (98)	47	18	10	14	9
4 (94)	50	19	5	12	8
5 (86)	47	18	5	8	8
6 (75)	39	13	7	11	5
Montserrado County					
Grade 1 (186)	86	58	20	16	6
2 (189)	119	39	18	9	4
3 (184)	133	27	16	4	4
4 (179)	132	31	10	3	3
5 (165)	119	35	7	2	2
6 (151)	116	25	8	0	2
Cape Mount County					
Grade 1 (65)	46	16	0	1	2
2 (60)	55	3	1	1	0
3 (56)	51	2	1	2	0
4 (52)	46	4	1	0	1
5 (42)	38	2	1	1	0
6 (34)	31	2	1	0	0
Lofa County					
Grade 1 (172)	85	54	19	10	4
2 (165)	114	35	8	5	3
3 (155)	114	27	10	2	2
4 (120)	89	19	7	3	2
5 (92)	73	10	5	2	3
6 (74)	57	10	4	1	2
Bong County					
Grade 1 (99)	46	25	13	11	4
2 (97)	57	16	10	9	5
3 (93)	58	20	11	4	0
4 (90)	63	16	7	3	1
5 (79)	55	16	7	0	1
6 (69)	48	16	4	0	1

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TABLE ONE (Continued)

County/City Grade Level No. of Schools	Size Distribution				
	1-20	21-40	41-60	61-100	101+
Nimba County					
Grade 1 (267)	150	69	26	13	9
2 (264)	172	62	15	8	7
3 (265)	190	49	13	7	6
4 (254)	193	37	14	6	4
5 (234)	189	27	9	5	4
6 (202)	164	26	5	5	2
Grand Bassa County					
Grade 1 (118)	75	29	4	8	2
2 (116)	93	13	4	6	0
3 (113)	91	12	6	4	0
4 (110)	93	9	5	3	0
5 (100)	83	12	4	1	0
6 (92)	78	8	6	0	0
Grand Gedeh County					
Grade 1 (103)	49	31	15	8	0
2 (102)	67	23	8	4	0
3 (95)	68	21	4	2	0
4 (98)	80	12	4	2	0
5 (77)	58	15	3	1	0
6 (67)	52	12	2	1	0
Sinoe County					
Grade 1 (122)	99	13	8	1	1
2 (122)	100	15	4	2	1
3 (123)	105	14	3	0	1
4 (110)	97	10	2	1	0
5 (90)	81	7	2	0	0
6 (90)	80	7	3	0	0
Maryland County					
Grade 1 (139)	88	31	8	5	7
2 (138)	102	20	10	5	1
3 (136)	108	16	8	3	1
4 (134)	105	18	8	3	0
5 (113)	94	13	5	0	1
6 (103)	83	15	4	1	0

criterion, is relatively higher than elsewhere in the elementary school system.

To determine if a different pattern would occur within the government elementary school sector after excluding all mission and other private schools, the 1981 enrollments data were reanalyzed. Table Two presents the results of this analysis. This breakdown of the data is especially appropriate since the tentative dissemination plans for IEL include government schools only. An examination of Table Two reveals a pattern of bias toward small class sizes at all grade levels, similar to that shown in Table One. However, as one would expect, given the attrition pattern in Liberian elementary schools, the small-class-size phenomenon is even more prevalent at upper grade levels.

Before proceeding to a more detailed analysis of the problem posed to the IEL system by class sizes in the government schools, it is useful to address the issue of the quality of this data and the determinants of the pattern of the class-size distributions which have been seen in Tables One and Two. The 1981 school enrollments survey by the Department of Planning and Development of the Liberian Ministry of Education has produced the most complete data set on enrollments available. The survey collected information, by school, on location, number of teachers, total grade levels taught, and enrollment by grade level from Kindergarten to Grade Six. The only incomplete data reported were for a few schools in Monrovia.

Obviously, the collection and tabulation of extensive data of this type are subject to error. However, the consistent pattern of results, the confirmation of patterns found in the earlier 1979 and 1977 surveys, and the

TABLE TWO

SIZE DISTRIBUTION OF CLASSES, GOVERNMENT SCHOOLS, 1981

BY GEOGRAPHIC DESIGNATION AND GRADE LEVEL

County/City Grade Level No. of Schools	Size Distribution				
	1-20	21-40	41-60	61-100	101+
Monrovia City					
Grade 1 (30)	4	3	3	6	14
2 (29)	4	5	4	6	10
3 (30)	5	4	4	9	8
4 (29)	9	2	4	6	8
5 (28)	9	5	2	4	8
6 (23)	5	4	2	7	5
Montserrado County					
Grade 1 (94)	46	27	8	9	4
2 (95)	58	19	9	7	2
3 (91)	64	16	7	2	2
4 (91)	67	15	6	1	2
5 (83)	56	20	5	0	2
6 (73)	52	15	4	0	2
Cape Mount County					
Grade 1 (35)	25	8	0	1	1
2 (33)	30	1	1	1	0
3 (31)	28	1	1	1	0
4 (31)	28	2	1	0	0
5 (24)	22	1	1	0	0
6 (19)	17	2	0	0	0
Lofa County					
Grade 1 (126)	64	39	11	8	4
2 (124)	88	25	3	5	3
3 (119)	91	17	7	2	2
4 (94)	74	13	2	3	2
5 (70)	57	6	3	1	3
6 (53)	44	3	3	1	2
Bong County					
Grade 1 (61)	26	11	10	11	3
2 (60)	28	14	8	7	3
3 (63)	35	14	10	4	0
4 (53)	38	9	2	3	1
5 (48)	32	10	5	0	1
6 (42)	28	10	3	0	1

Continued on Following Page

TABLE TWO (Continued)

County/City Grade Level No. of Schools	Size Distribution				
	1-20	21-40	41-60	61-100	101+
Nimba County					
Grade 1 (197)	108	52	20	10	7
2 (196)	132	42	13	3	6
3 (197)	146	37	5	3	6
4 (191)	154	23	7	3	4
5 (187)	161	16	2	4	4
6 (150)	132	8	4	4	2
Grand Bassa County					
Grade 1 (81)	54	19	3	3	2
2 (79)	65	9	2	3	0
3 (74)	63	6	3	2	0
4 (74)	64	6	2	2	0
5 (66)	57	6	3	0	0
6 (61)	54	4	3	0	0
Grand Gedeh County					
Grade 1 (82)	40	25	11	6	0
2 (80)	54	17	7	2	0
3 (79)	59	15	3	2	0
4 (76)	60	12	3	1	0
5 (61)	47	11	3	0	0
6 (51)	41	9	1	0	0
Sinoe County					
Grade 1 (103)	86	10	6	0	1
2 (102)	87	11	3	0	1
3 (103)	93	7	2	0	1
4 (95)	87	6	1	1	0
5 (82)	78	3	1	0	0
6 (74)	69	4	1	0	0
Maryland County					
Grade 1 (114)	75	26	2	4	7
2 (111)	86	15	6	3	1
3 (111)	91	9	7	3	1
4 (108)	90	11	4	3	0
5 (93)	78	11	3	0	1
6 (89)	72	13	3	1	0

use of class-size categories of at least twenty students assure that the general patterns of class size found in Tables One and Two are representative of the underlying reality of the Liberian school situation.

As to the determinants of the patterns themselves, the main forces at work are those of attrition and repetition. Because of attrition, one would normally find lower class sizes at each subsequent level. However, the factor of grade repetition counters this at certain grades. The incidence of repetition varies among schools, but it is not unusual to find the second or even third grade class as the largest class. In small schools this could be because of normal variation in entry numbers from year to year, but in the larger schools the larger second or third grade class enrollment is almost certainly a result of student repetition.

Another factor affecting the size distribution of classes is that some small schools have no students at a particular grade but have students at earlier and later grades. (The data used in this report are only for classes which had at least one student.) Other schools in the survey had less than the full elementary grade cycle. These include schools which stop before Grade Five or Six and others, such as the aforementioned junior high schools, which begin with Grades Five and Six. These "incomplete" schools create some unusual patterns of enrollment when, for example, students transfer to a school which has the upper-level courses. Thus, you can have three schools with ten students each in third grade and then find one school with twenty-five students at the fourth grade level. These unusual patterns of enrollment will pose problems for IEL dissemination in terms of per-student costs

and the need for adaptation of students who transfer from non-IEL schools to IEL schools.

Returning to the more basic problems of IEL dissemination, it is useful to examine the question of how many schools should be converted to IEL if IEL achievement results justify the wider implementation of the programmed teaching and programmed learning approaches. Because of the relative costs of IEL, it may be accepted that classes of over forty students would be efficient users of the IEL technology. If a class has from twenty to forty students, the IEL system may be slightly more expensive in day-to-day use than a textbook-based curriculum; and, if there are fewer than twenty students in a class, IEL is almost certainly going to be the more expensive system of learning.

It was stressed in Report No. 1 that IEL's justification is not that it is inexpensive but that it is more effective in terms of the net effect of costs and benefits. The achievement data do not yet confirm or deny this assertion with any finality. However, the proposals here will be based on an assumption of adequate effectiveness to justify each level of costs incurred.

In Table Three, each of the ten geographical areas of the survey is analyzed in terms of the percentage of schools with classes that fall below forty-one students and twenty-one students. This is done for Grades One, Three, and Six. The relevance of this analysis lies in the earlier discussion of relative efficiency: those schools with classes of twenty students or less are likely unsuited for IEL use unless substantial achievement gains can be shown to justify the cost differential. The larger threshhold of

TABLE THREE

INCIDENCE OF SMALL CLASSES, GOVERNMENT SCHOOLS, 1981

BY GEOGRAPHIC DESIGNATION AND GRADE LEVELS ONE, THREE, AND SIX

County/City Grade Level	Total Schools	Percent of Classes 40 or Below	Percent of Classes 20 or Below
Monrovia City			
Grade 1	30	23%	13%
3	30	30	17
6	23	39	22
Montserrado County			
Grade 1	94	78%	49%
3	91	88	70
6	73	92	71
Cape Mount County			
Grade 1	35	94%	71%
3	31	94	90
6	19	100	89
Lofa County			
Grade 1	126	82%	51%
3	119	91	76
6	53	89	83
Bong County			
Grade 1	61	61%	43%
3	63	78	56
6	42	90	67
Nimba County			
Grade 1	197	81%	55%
3	197	93	74
6	150	93	88
Grand Bassa County			
Grade 1	81	90%	67%
3	74	93	85
6	61	95	89
Grand Gedeh County			
Grade 1	82	79%	49%
3	79	94	75
6	51	98	80

Continued on Following Page

TABLE THREE (Continued)

County/City Grade Level	Total Schools	Percent of Classes 40 or Below	Percent of Classes 20 or Below
Sinoe County			
Grade 1	103	93%	83%
3	103	97	90
6	74	99	93
Maryland County			
Grade 1	114	89%	66%
3	111	90	82
6	89	96	81
Total for Liberia			
Grade 1	923	81%	57%
3	893	89	75
6	635	92	81
Total for Liberia Excluding Monrovia			
Grade 1	893	83%	59%
3	868	91	77
6	612	95	83

forty students or less per class could be used if one had less substantial but still positive achievement benefits shown for IEL students.

Interestingly, outside of Monrovia City (which has the lowest number of small government schools), only three counties (the remainder of Montserrado, Bong, and Grand Gedeh) would have more than fifty percent of their schools participate in IEL even if the lower cut-off of twenty students per class at Grade One were used. Two of those counties (Montserrado and Grand Gedeh) would still have forty-nine percent of their schools excluded from IEL, and the third (Bong) would have forty-three percent excluded. Assuming that the achievement of IEL students were such that dissemination only to the schools with classes above forty students was justified, then Monrovia and Bong County would be the only areas to include more than one-third of their schools in the dissemination plan.

If the class-size requirements were extended to the Grade Three level, then an even greater proportion of schools would be excluded from participation. For example, if IEL were to be implemented only in those schools where the first three grades had at least forty students each, only Montserrado and Bong Counties, and Monrovia City, would have more than one school in ten participate. (The figures would be twelve, twenty-two, and seventy percent for the three areas, respectively.) Even under the more liberal plan of disseminating to schools with an average of more than twenty students in each of the first three grades, only Montserrado, Bong, and Nimba Counties, and Monrovia City, would have more than one school in four participate.

The convergence of the twin realities of IEL costs and Liberian school size is striking and so will be its effect. If IEL is disseminated on the

basis of relative efficiency, it will be adopted primarily by the most urban counties, within all counties by the most urban schools, and within the urban school group by the largest (and presumably more advantaged) urban schools. The danger is that the IEL system will become a component of elite education, rather than serving its original purpose of providing greater educational opportunity for the poor, rural student. The only alternative, however, is to implement IEL in the small schools which constitute the majority of the Liberian educational environment.

Unfortunately, as it is presently constituted, the IEL system is uniquely unfit for such schools in cost, design, and management. Somewhere in the process of materials production and revision, the IEL curriculum designers lost sight of the original purpose of the project and/or of the nature of Liberian primary education. Whatever happened, only a program of redesign--of materials and of the delivery system--can salvage the project's original goals.

DISSEMINATION COSTS

The calculation of cost estimates for IEL dissemination requires the selection of a dissemination plan (Which schools in what sequence?) and a costing of the "IEL Dissemination Package." This package would consist of all of the activities related to conversion of a non-IEL school into a fully operating IEL institution. The earlier reports in the Cost Analysis Project have identified the following components of the IEL system:

- Modules and support materials;
- Classroom equipment;
- Teacher training; and
- Supervision.

In addition to programmed teaching and programmed learning modules, the materials component includes: review booklets, practice booklets, block and semester tests, test booklets, test answer keys, and an arts and crafts manual (for the upper three grades only). The classroom equipment component consists of the semester package boxes (which are designed to store the instructional materials), group chalkboards, and lap boards.

Pre-dissemination teacher training and post-dissemination supervisory assistance have not yet been articulated in a manner which allows for effective costing. The teacher training costs can be estimated from the 1983 teacher training programs for IEL and OC teachers, but the IEL program was staffed primarily by IEL project members. Thus, there is still uncertainty about the actual cost of feeding, lodging, and instructing the teachers for the final IEL system. In addition, the later programs may operate o a larger scale which may allow for some management economies not present in the 1983 training exercises.

While rough estimates are possible for the teacher training component, it is much too premature to estimate costs of the supervisory component. It is the goal of the IEL staff to incorporate existing Ministry of Education personnel into the supervisory network so as to avoid net cost increases. However, the requisite recruitment and training of such individuals have not been finalized. This dissemination component will undoubtedly involve some expense, but there is no basis at the moment to do other than accept

TABLE FOUR

IEL DISSEMINATION PACKAGE COSTS

BY GRADE

Package Component	Grade Level					
	One	Two	Three	Four	Five	Six
Modules/Materials	$446.70	$482.70	$540.93	$669.96	$669.96	$669.96
Semester Packages	53.00	53.00	53.00	53.00	53.00	53.00
Chalkboards	24.08	13.76	13.76	10.32	10.32	10.32
Lap Boards	9.00	5.40	4.60	3.80	3.20	3.00
Teacher Training	200.00	200.00	200.00	200.00	200.00	200.00
	$732.78	$754.86	$812.29	$937.08	$936.48	$936.28

(although with scepticism) the assurances that the net effect on the government because of IEL supervisory costs will be minimal.

Based on the data in Report No. 1 on unit costs, Table Four presents an estimate of the component expenses involved in an IEL dissemination package for each grade level. (A package provides all of the components necessary to implement IEL in one grade level in one school.) The modules/materials costs are based on the current IEL design and current materials costs. While the cost of the materials/modules and semester packages are unaffected by class size, the group chalkboards and individual lap boards would have to be included based upon the actual enrollment within each grade in a dissemination school. The dissemination package estimates have been based on the following class size figures:

Grade One	45
Grade Two	27
Grade Three	23
Grade Four	19
Grade Five	16
Grade Six	15

The teacher training cost figure is an estimate of the expense of preparing a single classroom teacher to work within the IEL system. The conservative estimate of $200 per teacher is subject to variation because of training group size, distance traveled, length of course, salaries of teacher trainers, and stipends paid to trainees, in addition to the direct instructional costs related to materials, equipment, and facilities. Only the teacher training amount (and the exclusion of any materials delivery and instructional supervisory costs) in Table Four is subject to any significant underestimation.

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The subsequent dissemination cost analysis will use the following rounded totals, by grade, of the IEL dissemination package for all further calculations:

Grade One	$730
Grade Two	750
Grade Three	810
Grade Four	940
Grade Five	940
Grade Six	940

The remaining requirement to estimate dissemination costs is to have a dissemination plan. Since no official IEL/Ministry of Education plan yet exists, an illustrative plan will be examined here. The Ministry of Education school survey data and the IEL dissemination package costing approach allow for the direct estimation of any dissemination strategy. Once a plan is designed, one only needs to identify the participant schools and the number of classrooms each has at each grade level. Then the package costs for each grade level can be multiplied by the number of dissemination classes at each grade level to obtain a total dissemination cost figure for each grade. This flexibility allows for the calculation of the dissemination in phases, as well, regardless of whether phasing is by geographical location, school size, grade level, or any combination.

The hypothetical dissemination plan to be analyzed here is assumed to have three phases. In Part I, all government schools that have at least forty students at each grade level up to Grade Four will receive the IEL instruction system. In Part II, IEL will be further expanded to include the schools which have more than twenty but fewer than forty students at each grade up to Grade Four. Finally, Part III of the dissemination will see IEL

introduced into any government school which has ten or more students at each grade level from Grade One to Grade Four. It is assumed throughout that, if a school qualifies for dissemination, regardless of the size of classes at the Grade Five and Grade Six level, they also will receive the IEL system. In selecting schools it was necessary that they have classes at each grade from first to fourth, but it was not required that dissemination schools have a fifth or a sixth grade. The latter issue was a factor only in the Part III dissemination.

Table Five presents the population of schools, by geographical area, that would participate in Part I of the dissemination plan. The table indicates the number of IEL classes which would operate at each grade level. These figures were estimated by dividing total enrollment in a grade level by sixty (an optimal class size for IEL in terms of costs) and by assuming that one class would exist for every sixty students or partial multiple thereof. Thus, if a school had a first grade enrollment of 165 students, three IEL classes would be created; and if it had 190 students, four classes would be put into operation. In reality, smaller or larger class sizes might exist, and this would increase or reduce the number of IEL packages required for dissemination. Effective planning, however, should assure that the actual class size adheres to the IEL optimum as closely as feasible.

Table Five once again points up the major anomaly of the IEL system. Monrovia City is the largest single participant in the program even though the size criterion for Part I (forty students) is signficantly below the IEL optimum (sixty students) for relative cost efficiency. The most rural counties--Cape Mount, Grand Bassa, Grand Gedeh, and Sinoe--are not heavily represented in Part I.

TABLE FIVE

DISSEMINATION PLAN: PART I*

BY GEOGRAPHIC DESIGNATION AND GRADE LEVEL

County/City (No. of Schools)		IEL Packages by Grade Level					
		One	Two	Three	Four	Five	Six
Monrovia City	(17)	59	44	41	39	35	31
Montserrado County	(9)	21	18	14	14	12	11
Cape Mount County	(1)	4	2	2	1	1	1
Lofa County	(7)	20	16	13	13	13	11
Bong County	(7)	17	15	10	9	8	9
Nimba County	(13)	36	28	24	21	20	19
Grand Bassa County	(3)	7	6	5	5	3	3
Grand Gedeh County	(3)	5	6	5	4	2	2
Sinoe County	(3)	7	5	5	4	3	3
Maryland County	(6)	13	10	9	8	7	7
TOTAL	(69)	189	150	128	118	104	97

*All government schools with at least forty students at each grade level up to Grade Four.

Tables Six and Seven present the information on school participation by geographical area for Parts II and III of the dissemination plan, respectively. It is important to remember that Part III of the plan is based upon a criterion (ten students per class) which is well below the level at which IEL has any likelihood of approaching cost comparability with the textbook alternative. The only exception would be if the Ministry of Education curriculum materials project fails dramatically in its attempt to design and implement a low-cost textbooks alternative.

Finally, Table Eight presents the dissemination cost estimate for Parts I, II, and III by grade level. The total cost for initial dissemination of IEL to the selected 361 schools (forty percent of all government schools) is estimated to be $2,130,910. Part III is the most expensive phase, because of the larger number of schools; and Grades Four and One are the most expensive grade levels, because of the greater materials expense and greater number of classrooms, respectively. These totals do not include materials delivery and instructional supervision expenses.

In actual dissemination, phasing over time would be a reasonable strategy alternative. Data such as developed here will allow for estimation of costs by year regardless of whether all schools are phased simultaneously or schools are introduced into IEL in a staggered format by grade and year. Given the sequential linkage of the IEL materials, it may not be useful to introduce IEL materials into all grade levels of a school at once. Phasing over time by grade, by location, and by whatever other criteria seem useful is an important alternative for fiscal reasons as well. Phasing in the dissemination system over a period of years reduces the initial cost impact of IEL adoption and also allows more time for the Government of Liberia to

TABLE SIX

DISSEMINATION PLAN: PART II*

BY GEOGRAPHIC DESIGNATION AND GRADE LEVEL

County/City (No. of Schools)		IEL Packages by Grade Level					
		One	Two	Three	Four	Five	Six
Monrovia City	(3)	6	3	3	3	3	2
Montserrado County	(15)	19	15	15	15	15	15
Cape Mount County	(2)	2	2	2	2	2	2
Lofa County	(14)	19	15	14	14	14	14
Bong County	(11)	14	14	11	11	11	11
Nimba County	(27)	32	28	27	27	27	27
Grand Bassa County	(9)	11	9	9	9	9	9
Grand Gedeh County	(11)	14	11	11	11	11	11
Sinoe County	(5)	5	5	5	5	5	5
Maryland County	(10)	18	10	11	10	10	10
TOTAL	(107)	140	112	108	107	107	106

*All government schools with more than twenty but fewer than forty students at each grade level up to Grade Four.

TABLE SEVEN

DISSEMINATION PLAN: PART III*

BY GEOGRAPHIC DESIGNATION AND GRADE LEVEL

County/City (No. of Schools)		IEL Packages by Grade Level					
		One	Two	Three	Four	Five	Six
Monrovia City	(4)	5	4	4	4	4	4
Montserrado County	(23)	24	23	23	23	22	21
Cape Mount County	(5)	5	5	5	5	5	5
Lofa County	(19)	19	19	19	19	10	7
Bong County	(16)	17	16	16	16	15	14
Nimba County	(44)	44	44	44	44	43	37
Grand Bassa County	(12)	12	12	12	12	12	12
Grand Gedeh County	(18)	18	18	18	18	15	14
Sinoe County	(19)	19	19	19	19	19	19
Maryland County	(25)	25	25	25	25	22	22
TOTAL	(185)	188	185	185	185	167	155

*All government schools with more than twenty but fewer than forty students at each grade level up to Grade Four.

TABLE EIGHT

DISSEMINATION COSTS

BY GEOGRAPHIC DESIGNATION AND GRADE LEVEL

County/City Dissemination Plan (No. of Schools)	Dissemination Costs by Grade Level						
	One	Two	Three	Four	Five	Six	Total
Monrovia City							
Part I (17)	$ 43,070	$ 33,000	$ 33,210	$ 36,660	$ 32,900	$ 29,140	$ 207,980
Part II (3)	4,380	2,250	2,430	2,820	2,820	1,880	16,580
Part III (4)	3,650	3,000	3,240	3,760	3,760	3,760	21,170
TOTAL	$ 51,100	$ 38,250	$ 38,880	$ 43,240	$ 39,480	$ 34,780	$ 245,730
Montserrado City							
Part I (9)	$ 15,330	$ 13,500	$ 11,340	$ 13,160	$ 11,280	$ 10,340	$ 74,950
Part II (15)	13,870	11,250	12,150	14,100	14,100	14,100	79,570
Part III (23)	17,520	17,250	18,630	21,620	20,680	19,740	115,440
TOTAL	$ 46,720	$ 42,000	$ 42,120	$ 48,880	$ 46,060	$ 44,180	$ 269,960
Cape Mount County							
Part I (1)	$ 2,920	$ 1,500	$ 1,620	$ 940	$ 940	$ 940	$ 8,860
Part II (2)	1,460	1,500	1,620	1,880	1,880	1,880	10,220
Part III (5)	3,650	3,750	4,050	4,700	4,700	4,700	25,550
TOTAL	$ 8,030	$ 6,750	$ 7,290	$ 7,520	$ 7,520	$ 7,520	$ 44,630

Continued on Following Page

TABLE EIGHT (Continued)

County/City Dissemination Plan (No. of Schools)		Dissemination Costs by Grade Level						
		One	Two	Three	Four	Five	Six	Total
Lofa County								
Part I	(7)	$ 14,600	$ 12,000	$ 10,530	$ 12,220	$ 12,220	$ 10,340	$ 71,910
Part II	(14)	13,870	11,250	11,340	13,160	13,160	13,160	75,940
Part III	(19)	13,870	14,250	15,390	17,860	9,400	6,580	77,350
TOTAL		$ 42,340	$ 37,500	$ 37,260	$ 43,240	$ 34,780	$ 30,080	$ 225,200
Bong County								
Part I	(7)	$ 12,410	$ 11,250	$ 8,100	$ 8,460	$ 7,520	$ 8,460	$ 56,200
Part II	(11)	10,220	10,500	8,910	10,340	10,340	10,340	60,650
Part III	(16)	12,410	12,000	12,960	15,040	14,100	13,160	79,670
TOTAL		$ 35,040	$ 33,750	$ 29,970	$ 33,840	$ 31,960	$ 31,960	$ 196,520
Nimba County								
Part I	(13)	$ 26,280	$ 21,000	$ 19,440	$ 19,740	$ 18,800	$ 17,860	$ 123,120
Part II	(27)	23,360	21,000	21,870	25,380	25,380	25,380	142,370
Part III	(44)	32,120	33,000	35,640	41,360	40,420	34,780	217,320
TOTAL		$ 81,760	$ 75,000	$ 76,950	$ 86,480	$ 84,600	$ 78,020	$ 482,810

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TABLE EIGHT (Continued)

County/City Dissemination Plan (No. of Schools)	Dissemination Costs by Grade Level						
	One	Two	Three	Four	Five	Six	Total
Grand Bassa County							
Part I (3)	$ 5,110	$ 4,500	$ 4,050	$ 4,700	$ 2,820	$ 2,820	$ 24,000
Part II (9)	8,030	6,750	7,290	8,460	8,460	8,460	47,450
Part III (12)	8,760	9,000	9,720	11,280	11,280	11,280	61,320
TOTAL	$ 21,900	$ 20,250	$ 21,060	$ 24,440	$ 22,560	$ 22,560	$ 132,770
Grand Gedeh County							
Part I (3)	$ 3,650	$ 4,500	$ 4,050	$ 3,760	$ 1,880	$ 1,880	$ 19,720
Part II (11)	10,220	8,250	8,910	10,340	10,340	10,340	58,400
Part III (18)	13,140	13,500	14,580	16,920	14,100	13,160	85,400
TOTAL	$ 27,010	$ 26,250	$ 27,540	$ 31,020	$ 26,320	$ 25,380	$ 163,520
Sinoe County							
Part I (3)	$ 5,110	$ 3,750	$ 4,050	$ 3,760	$ 2,820	$ 2,820	$ 22,310
Part II (5)	3,650	3,750	4,050	4,700	4,700	4,700	25,550
Part III (19)	13,870	14,250	15,390	17,860	17,860	17,860	97,090
TOTAL	$ 22,630	$ 21,750	$ 23,490	$ 26,320	$ 25,380	$ 25,380	$ 144,950

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TABLE EIGHT (Continued)

County/City Dissemination Plan (No. of Schools)	Dissemination Costs by Grade Level						
	One	Two	Three	Four	Five	Six	Total
Maryland County							
Part I (6)	$ 9,490	$ 7,500	$ 7,290	$ 7,520	$ 6,580	$ 6,580	$ 44,960
Part II (10)	13,140	7,500	8,910	9,400	9,400	9,400	57,750
Part III (25)	18,250	18,750	20,250	23,500	20,680	20,680	122,110
TOTAL	$ 40,880	$ 33,750	$ 36,450	$ 40,420	$ 36,660	$ 36,660	$ 224,820
TOTAL FOR LIBERIA							
Part I (69)	$137,970	$112,500	$103,680	$110,920	$ 97,760	$ 91,180	$ 654,010
Part II (107)	102,200	84,000	87,480	100,580	100,580	99,640	574,480
Part III (185)	137,240	138,750	149,850	173,900	156,980	145,700	902,420
GRAND TOTAL	$377,410	$335,250	$341,010	$385,400	$355,320	$336,520	$2,130,910

prepare for the new recurrent cost effects. Both of these fiscal advantages are noteworthy given the other financial demands on the government and the current restricted resource capacity of the nation.

The plan reviewed here is only a hypothetical one, of course. The final dissemination plan designed for IEL, if it is implemented beyond the experimental stage, undoubtedly will differ greatly from the one shown here. However, the approach to costing will be exactly as that used in this analysis. It is important to recognize that the greatest value of the costing system reviewed above is that it has major advantages for both planning of implementation and for analysis of its effects. Resource constraints will be an important issue to any dissemination planning committee, and this costing approach allows for direct and rapid costing of a variety of alternative plans based on varying dissemination criteria. The planners can then discard those plans which imply demands beyond the current level of funding capacity and concentrate on the fiscally realistic alternatives.

In the concluding section of this report, two final activities will be accomplished. First, a review of the major conclusions concerning the financial and non-financial constraints to IEL will be presented. Second, a set of recommendations will be made as to the structure and responsibilities of the proposed IEL dissemination planning committee. If dissemination is to occur rationally and with minimal unnecessary expense, the work of the planning committee is as urgent as it will be challenging.

SUMMARY AND RECOMMENDATIONS

The ability and willingness of the Liberian government to absorb the costs of IEL dissemination and of IEL recurrent costs (an annual amount equal

to about one-fifth of the initial dissemination costs) will be dependent upon the future resources available to the government and the proven relative effectiveness of IEL in terms of student achievement. To the extent that external funding is available to assist in underwriting the dissemination costs, the willingness to expand the implementation of IEL will be increased. But the government must be assured of its own ability to absorb and maintain the increases in the annual budget of the Ministry of Education which would be caused by wider use of the IEL instructional program. One may expect increased budgetary demands simply as a result of the normal expansion of the present educational system. In addition, it is important to remember that removal of the austerity wage constraints on teachers and Ministry of Education personnel would, by itself, result in an increase of fifteen to twenty percent in wage and salary costs.

Simultaneous with the proposal to disseminate IEL, the Ministry of Education will face new demands from secondary and higher education institutions. Outside the Ministry of Education, the government will face new requests for funds from a variety of social and infrastructure needs. Thus, the decision as to whether, when, and how any IEL dissemination will occur remains exceedingly uncertain at this time.

The major benefit of this report is in indicating the continuing problems of the fit of the IEL system to the actual characteristics of Liberian elementary schools and in formulating a basic dissemination planning format for costing. The latter should play an important role in the work of the IEL dissemination planning group. In this concluding section of the report some brief recommendations will be made concerning the structure and work of this committee.

It would be of a great ultimate benefit if the work of the planning committee could be started immediately. A joint planning structure should be initiated with representatives from the IEL project staff, USAID/EHR, and the Ministry of Education's Department of Planning and Development. Additional committee members from elsewhere in the Ministry, elsewhere in the government, or from outside the government should be appointed as required by the committee's responsibilities. The initial charge to the committee should be to draft a proposed dissemination plan including recommendations for school selection and phasing by schools, by grade level, and by geographic regions.

IEL project funds are said to include resources for the recruitment of a dissemination consultant. This consultant should be someone whose main experience and work skills are in the area of educational planning rather than in curriculum design. It is mandatory, of course, that the consultant be informed fully as to the IEL curriculum technology and be sensitive to its advantages and disadvantages. However, the main demands of the dissemination planning process will be on production and delivery issues, not on issues of materials design.

The dissemination planning committee should begin by identifying the dissemination capacity of IEL in terms of the non-cost constraints. As noted earlier, these relate to the physical capacity to produce and distribute materials and equipment, to provide pre-dissemination teacher training, and to design and implement post-dissemination supervisory services. The information on these constraints will allow the committee to establish an upper limit on the feasible physical scale of dissemination in terms of the number of classrooms.

The next step in planning will be to establish several planning scenarios which can be costed. Given a certain capacity in terms of the number of IEL classroom packages that can be produced for a dissemination year, one can vary the number of schools to which dissemination occurs by establishing different dissemination criteria. For example, if production of 500 IEL dissemination packages of materials, teacher training, and supervision are feasible, then 500 first grade classes or 250 first and second grade classes, and so on can be implemented. The more schools that have multiple classes at a single grade level, the fewer the total number of schools that the IEL dissemination can reach.

Each of the planning scenarios can then be costed to determine if the proposals are fiscally realistic. This two-level approach to dissemination planning--first evaluating physical capacity and then evaluating fiscal capacity--offers the most promising and flexible design for the dissemination committee's planning. The design system should be flexible enough to encompass any special dissemination consideration that the consultant or committee members wish to introduce.

Since the 1983 evaluation should produce more reliable data on IEL achievement effects by grade level, the dissemination planners will be able to present policy decision-makers with estimates of the dissemination costs, recurrent costs, and probable learning effects for each dissemination scenario they propose. This data will allow the type of reasoned cost-utility evaluation of the IEL program that is mandatory given its potential effects on government resources and individual lives.

The advantages of the IEL system of programmed teaching and programmed learning have, to date, remained largely those of asserted logical effects and intuitive implications. As the IEL Cost Analysis Project reports have

shown, the cost implications of IEL are such that more concrete, objective, and dramatic benefits of IEL must be shown in the 1983 achievement evaluation before wider implementation of IEL can be justified. Even if such justification is forthcoming, there will still exist a need for careful planning of the dissemination process for IEL. The dissemination planning process cannot, unfortunately, await the outcome of the 1983 evaluation. The planning committee should be created and begin its work immediately. Further delay poses problems in terms of cost and effectiveness of the dissemination process itself. The IEL instructional program, given its other limitations, cannot afford a poorly implemented dissemination program.

VI

Cost Estimates of the Revised Improved Efficiency of Learning (IEL) Project's Materials Component

Supplemental Report to the IEL Cost Analysis Project

Douglas M. Windham

September 1983

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COST ESTIMATES OF THE REVISED

"IMPROVED EFFICIENCY OF LEARNING"

PROJECT'S MATERIALS COMPONENT

INTRODUCTION

As a result of the four reports prepared in the Improved Efficiency of Learning (IEL) Cost Analysis Project, project staff have made substantial revisions in the materials component of the instructional program. The results of this revision exercise are summarized in S. Thiagarajan's report entitled "A Report on the IEL Cost Reduction Project" dated 7 July 1983.

These revisions in the IEL Project occurred primarily as a response to the findings of the Cost Analysis Project that IEL's original design did not match certain realities (especially that of normal class size) of the Liberian elementary education system. It is important to cite, however, Thiagarajan's assertion that "the suggested recommendations would have been implemented independent of the cost-cutting requirements (p.8, original emphasis). He cites problems of classroom management, dissatisfaction with Programmed Teaching (PT) practice booklets, scheduling difficulties, and excessively large group sizes as factors which encouraged materials revision independent of the cost criterion. As was noted at several points in the Cost Analysis Project, the economist's role can be only to identify areas of cost concern; IEL Project revision remained a responsibility of the curriculum specialists. It is gratifying that both sets of concerns -- cost and curricular -- could be dealt with by the same set of revisions.

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THE IEL COST REDUCTION PROJECT

IEL senior staff, writers, Instructional Supervisors, and advisors worked collaboratively to identify areas where IEL could be revised so as to reduce materials cost and either maintain or improve curricular benefits. The Thiagarajan report provides detail on the cost reduction procedure, criteria, and results. In the PT system (Grades One and Two and the first semester of Grade Three) the number of copies of review booklets was reduced from 15 to 7; reading booklets were reduced from 15 to 5; and practice booklets from 5 to 1. In the Programmed Learning (PL) system (the second semester of Grade Three and Grades Four, Five, and Six) the number of PL module copies was reduced from 7 to 3, and 4 out of 12 PL modules were identified as "optional" modules. Only one copy of each optional module is now contained in the Semester Package of IEL materials.

To appreciate the effect of these reforms on the IEL materials requirement we need only compare Table One and Table Two. Table One presents the original materials requirements for IEL by grade level. Table Two presents the revised material requirements under the changes noted above. The repackaging of modules saves a few pages at Grades One and Two, but the original module structure remains the same. However, the substantial reform in the support materials requirement reduces the page content total for Grade One from 7,445 to 3,528 for a single Semester Package. The same figures for Grade Two are 8,045 pages and 4,570 pages. For the PL system in Grades Four, Five, and Six, materials requirements for an individual Semester Package have been reduced from 11,166 pages to 4,664.

TABLE ONE

MATERIALS REQUIREMENTS FOR IEL

(PER SEMESTER PACKAGE)
(ORIGINAL)

	Originals	Copies	Average No. of Pages	Total Pages
Programmed Teaching				
Grade One				
Modules	20	1	80	1,600
Review Booklets	4	15	74	4,440
Practice Booklets	14	5	20	1,400
Semester Test	1	1	5	5
Grade Two				
Modules	20	1	80	1,600
Reading Booklets	1	15	40	600
Review Booklets	4	15	74	4,440
Practice Booklets	14	5	20	1,400
Semester Test	1	1	5	5
Grade Three (I)				
Modules	20	1	80	1,600
Reading Booklets	1	15	80	1,200
Review Booklets	4	15	74	4,440
Practice Booklets	14	1	20	1,400
Semester Test	1	1	5	5
Programmed Learning				
Grade Three (II)				
Modules	50	7	24	8,400
Student Guides	1	10	2	20
Test Booklets	10	7	12	840
Test Answer Keys	1	1	48	48
Block & Semester Tests	1	1	78	78
Grades Four, Five and Six (Per grade)				
Modules	60	7	24	10,080
Student Guides	1	10	2	20
Test Booklets	10	7	12	840
Test Answer Keys	1	1	48	48
Block & Semester Tests	1	1	78	78
Arts & Crafts Manual	1	1	100	100

Source: Windham, Report No. 1, 1983, p. 15.

TABLE TWO

MATERIALS REQUIREMENTS FOR IEL

(PER SEMESTER PACKAGE)
(REVISED)

	Originals	Copies	Average No. of Pages	Total Pages
Programmed Teaching				
Grade One				
Modules	20	1	80	1,595
Review Booklets	4	7	74	1,568
Practice Booklets	14	1	25	350
Semester Test	1	1	15	15
Grade Two				
Modules	20	1	80	1,541
Reading Booklets	1	5	40	200
Review Booklets	4	7	88	2,464
Practice Booklets	14	1	25	350
Semester Test	1	1	15	15
Grade Three (I)				
Modules	20	1	80	1,382
Reading Booklets	1	5	149	745
Review Booklets	4	7	387	2,709
Practice Booklets	14	1	25	350
Semester Test	1	1	5	15
Programmed Learning				
Grade Three (II)				
Modules	40	3	24	2,880
E/R Modules	10	1	24	240
Student Guides	1	10	2	20
Test Booklets	10	5	12	600
Test Answer Keys	1	1	70	70
Block & Semester Tests	1	1	50	50
Grade Four, Five and Six (Per grade)				
Modules	40	3	24	3,360
E/R Modules	20	1	24	480
Student Guides	1	2	2	4
Test Booklets	10	5	12	600
Test Answer Keys	1	1	70	70
Block & Semester Tests	1	1	50	50
Arts & Crafts Manual	1	1	100	100

Source: Thiagarajan, 1983, p. 11.

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Obviously, these dramatic reductions in page content will have a similarly dramatic effect on production expense. Table Three presents a cost comparison between the original and revised IEL materials requirements for each grade level. The total pages for a grade level are for an annual IEL instruction period (two Semester Packages), except for Grade Three where the PT and PL semesters are presented separately.

The costs in Table Three are presented both in production terms (printing costs) and in annual terms. The figures for the expected materials life of modules and other materials are taken from IEL staff estimates. While these expected amounts may be optimistic, the accuracy of the figure does not affect the comparison since the same expected life is used for both the original and the revised IEL systems. The annual estimated saving per class from changing to the revised IEL system would be as follows:

Grade One	- $47.09
Grade Two	- 42.76
Grade Three	- 55.79
Grade Four	- 78.02
Grade Five	- 78.02
Grade Six	- 78.02

While the savings are largest at the PL levels, even at Grades One and Two the savings represent a reduction of 39.9 percent and 34.1 percent, respectively.

The ultimate financial criterion for the IEL cost-effectiveness justification remains the relative costs of IEL to the use of the textbook alternatives. Table Four presents relative per-student costs for instructional materials at each grade level for five alternatives:

TABLE THREE

COST COMPARISON: ORIGINAL VERSUS REVISED

IEL MATERIALS

ITEM	TOTAL PAGES ORIGINAL	TOTAL PAGES REVISED	PRINTING COST ORIGINAL	PRINTING COST REVISED	EXPECTED MATERIALS LIFE	ANNUAL COST ORIGINAL	ANNUAL COST REVISED
Grade One							
Modules	3,200	3,190	$96.00	$95.70	2	$48.00	$47.85
Other Materials	11,690	3,866	350.70	115.98	5	70.14	23.20
Total	14,890	7,056	446.70	211.68		118.14	71.05
Grade Two							
Modules	3,200	3,082	$96.00	$92.46	2	$48.00	$46.23
Other Materials	12,890	6,058	368.70	181.74	5	77.34	36.35
Total	16,090	9,140	482.70	274.20		125.34	82.58
Grade Three (I)							
Modules	1,600	1,382	$48.00	$41.46	2	$24.00	$20.73
Other Materials	7,045	3,819	211.35	114.57	5	42.27	22.91
Total	8,645	5,201	259.35	156.03		66.27	43.64
Grade Three (II)							
All Materials	9,386	3,860	$281.58	$115.80	5	$56.32	$23.16
Grade Four							
All Materials	22,332	9,328	$669.96	$279.84	5	$133.99	$55.97
Grade Five							
All Materials	22,332	9,328	$669.96	$279.84	5	$133.99	$55.9
Grade Six							
All Materials	22,332	9,328	$669.96	$279.84	5	$133.99	$55.9

TABLE FOUR

RELATIVE PER-STUDENT COSTS OF INSTRUCTIONAL MATERIALS

Grade Level and Instructional Material	NUMBER OF STUDENTS IN CLASS		
	20	40	60
Grade One			
IEL (Original)	$5.91	2.95	1.97
IEL (Revised)	3.55	1.78	1.18
Textbook (A)	9.38	9.38	9.38
Textbook (B)	4.69	4.69	4.69
Textbook (C)	2.35	2.35	2.35
Grade Two			
IEL (Original)	$6.27	3.13	2.09
IEL (Revised)	4.13	2.06	1.38
Textbook (A)	10.88	10.88	10.88
Textbook (B)	5.44	5.44	5.44
Textbook (C)	2.72	2.72	2.72
Grade Three			
IEL (Original)	$6.11	3.07	2.04
IEL (Revised)	3.34	1.67	1.11
Textbook (A)	10.73	10.73	10.73
Textbook (B)	5.37	5.37	5.37
Textbook (C)	2.68	2.68	2.68
Grade Four			
IEL (Original)	$6.70	3.35	2.23
IEL (Revised)	2.80	1.40	.93
Textbook (A)	9.42	9.42	9.42
Textbook (B)	4.71	4.71	4.71
Textbook (C)	2.36	2.36	2.36
Grade Five			
IEL (Original)	$6.70	3.35	2.23
IEL (Revised)	2.80	1.40	.93
Textbook (A)	11.65	11.65	11.65
Textbook (B)	5.83	5.83	5.83
Textbook (C)	2.91	2.91	2.91
Grade Six			
IEL (Original)	$6.70	3.35	2.23
IEL (Revised)	2.80	1.40	.93
Textbook (A)	9.02	9.02	9.02
Textbook (B)	4.51	4.51	4.51
Textbook (C)	2.26	2.26	2.26

(1) The original IEL system.
(2) The revised IEL system.
(3) Textbook A - use of approved texts at current prices, one book per student.
(4) Textbook B - use of approved texts at reduced prices resulting from World Bank project, one book per student.
(5) Textbook C - same as Textbook B alternative but assumes two students share one book.

The IEL system, as revised, still retains important economies of scale. It is most efficient relative to the textbook alternatives at the larger class sizes. However, because of the revisions in page quantities, IEL is now much more competitive at the small class sizes which dominate in the Liberian educational system at these grade levels. For a class size of twenty, the IEL revised system is now less expensive, at every grade level, than textbook alternatives A and B and is lower even than alternative C at Grade Five. Given the resistance to the shared textbook system, the IEL system can now be characterized as comparable in cost to the textbook alternative at small class sizes and substantially more economical at the larger class sizes. The effect of the revisions in the PL grades is especially important because these are the grade levels where class size averages are the smallest. The reduction from a per-student cost of $6.70 to one of $2.80 for class sizes of twenty students means that IEL will now be more suitable for the majority of primary school students.

The problem of IEL instructional costs at class sizes below twenty remains a problem. The primary justification for the use of IEL in these schools will have to come from evidence of greater learning effectiveness. The nature of instruction in these small classes is such that IEL should be an especially valuable resource in dealing with their

problems. These benefits may well be sufficient to justify any residual cost disadvantages.

IMPLICATIONS FOR COST-EFFECTIVENESS AND FOR DISSEMINATION PLANNING

These costs estimates of the revised IEL materials-use system suggest that the burden previously placed on the effectiveness analysis has been reduced. Under the original costs estimates, it was necessary for IEL to show substantial learning benefits in order to justify its cost disadvantage. With cost comparability achieved for class sizes down to twenty, it will now be possible to support IEL implementation more readily given any improvements in learning gains (whether measured by process or product indicators).

As discussed above, the residual issue is the justification of IEL for schools with class sizes below twenty students each. For these schools it will be necessary to justify implementation in terms of the relative gain in effectiveness in benefits versus costs.

The effect of the cost reductions on dissemination expense is to reduce substantially both the initial dissemination costs and the recurrent costs for continued use of the IEL program. Table Five presents the IEL dissemination package costs for the original IEL materials. The dissemination package includes the modules and materials for a full year, two Semester Package boxes, and a number of chalkboards and lapboards appropriate to the class size. In addition, an estimate of teacher training costs per class is provided. The estimates were based on the following average class sizes per grade:

TABLE FIVE

ORIGINAL IEL DISSEMINATION PACKAGE COSTS

Package Component	Grade Level					
	One	Two	Three	Four	Five	Six
Modules/Materials	$446.70	$482.70	$540.93	$669.96	$669.96	$669.96
Semester Packages	53.00	53.00	53.00	53.00	53.00	53.00
Chalkboards	24.08	13.76	13.76	10.32	10.32	10.32
Lap Boards	9.00	5.40	4.60	3.80	3.20	3.00
Teacher Training	200.00	200.00	200.00	200.00	200.00	200.00
	$732.78	$754.86	$812.29	$937.08	$936.48	$930.28

Source: Windham, Report No. 4, 19[illegible], p. 19.

Grade One	- 45
Grade Two	- 27
Grade Three	- 23
Grade Four	- 19
Grade Five	- 16
Grade Six	- 15

The cost reductions resulting from the revision of IEL materials will produce an initial per class savings of $235.02 in Grade One, $208.50 in Grade Two, $269.10 in Grade Three, and $390.12 in each of the Grades Four to Six. The new dissemination package costs, per class, are as follows:

Grade One	- $497.76
Grade Two	- 546.36
Grade Three	- 543.19
Grade Four	- 546.96
Grade Five	- 546.[illegible]
Grade Six	- 546.16

In Report No. 4, a three-part dissemination program for Liberian government schools was analyzed. Part I consisted of all schools that had at least forty students at each level up to Grade Four; Part II included all schools with more than twenty but fewer than forty students at each grade up to Grade Four; and Part III included any remaining schools with ten or more students at each grade from Grade One to Grade Four. Table Six presents a comparison of the national totals for dissemination, by each part and by grade.

The estimated savings of $774,780 for materials for the initial dissemination represent a reduction of 36.3 percent from the original total. As noted in Report 4, however, this dissemination estimate covers only 361 schools (approximately 40 percent of all government elementary schools). The remaining 60 percent of schools do not meet the minimum criteria even for Part III of the plan, i.e., a minimum of

TABLE SIX

DISSEMINATION COSTS BY GRADE LEVELS

ORIGINAL AND REVISED IEL SYSTEM

Item	GRADE LEVEL						Total
	One	Two	Three	Four	Five	Six	
Original IEL System							
PART I	$137,970	112,500	103,680	110,920	97,760	91,180	654,01[illegible]
PART II	102,200	84,000	87,480	100,580	100,580	99,640	574,48[illegible]
PART III	137,240	138,750	149,850	173,900	156,980	145,700	902,42[illegible]
TOTAL	$377,410	335,250	341,010	385,400	355,320	336,520	2,130,91[illegible]
Revised IEL System							
PART I	$ 94,500	81,750	69,760	64,310	56,680	52,865	419,865
PART II	70,000	61,040	58,860	58,315	58,315	57,770	364,300
PART III	94,000	100,825	100,825	100,825	91,015	84,475	571,965
TOTAL	258,500	243,615	229,445	223,450	206,010	195,110	1,356,130

ten students in each grade from Grade One to Grade Four. Part III remains the most expensive phase of dissemination because of the larger number of separate classrooms; Grades One and Two (rather than One and Four) are the most expensive grade levels.

It is important to remember that these are conservative estimates and do not include materials delivery and instructional supervision expenses. In addition, the present class distribution by size in the Liberian system may be such that more schools would meet the minimum criteria for inclusion in the dissemination plan.

SUMMARY

The cost reduction project has accomplished a great deal in meeting the criticisms which were made in the cost analysis reports. The absolute levels of cost reduction are dramatic and the largest cost reductions were made for the PL grade level where class sizes were most likely to be very small. If the new learning system can be instituted without loss of instructional benefits, then the overall cost effectiveness of the IEL system relative to any of the textbook alternatives is greatly enhanced. A residual problem is the case of the 60 percent of elementary schools with very small class sizes. Both management and cost issues remain for these schools. The policy decision is whether they will receive IEL materials regardless of class size. The most reasonable strategy is to phase dissemination in such a way that the very small schools would receive IEL materials last. This allows time for enrollments to increase and for IEL staff to develop, if necessary, special adaptive strategies for this group of schools.

The major research/planning activities for 1983/84 are for a revised evaluation program and for the design of a dissemination plan. As noted in Report No. 3, the evaluation program should incorporate process effects as well as summative test scores as the benefits measure. The dissemination planning has not proceeded to a point where the important decisions of the "who, where, when, and how" of IEL implementation can be answered. The fiscal cost projections of dissemination and the estimation of the IEL recurrent costs must await finalization of the dissemination plan or plan alternatives. There is also no need at the present time to reassess the cost parameters or the size distribution of classes. All of these activities may be left to the time when the dissemination plan or plan alternatives are ready for costing.

While the IEL cost reductions do not "prove" IEL to be the more cost-effective strategy for Liberia, they do advance the probability that IEL is the more appropriate strategy. Given the information available on the IEL system's success at transforming learning where implemented, one may expect the final analysis of cost-effectiveness to support IEL's further development and dissemination.

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VII

Programmed Instruction as a Means of Improving Student Achievement:

A look at the Liberian IEL Project

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PROGRAMMED INSTRUCTION AS A MEANS OF IMPROVING STUDENT ACHIEVEMENT: A look at the Liberian IEL Project

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Low quality primary-school instruction is recognized as an impediment to economic and social development in many developing countries. Efforts to improve instructional quality, however, often encounter problems of increasing educational costs, shrinking budgets, lack of instructional materials, and large numbers of unqualified teachers.

One strategy for improving educational quality that is gaining popularity in many countries is the use of programmed instruction. This approach employs highly structured curricular materials (e.g., programed instruction) in an effort to equalize the instructional treatment and classroom interactions experienced by students across different classrooms and schools. Programmed instruction can be developed at a relatively low cost and is seen as a means of compensating for poorly prepared

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1 - Portions of this paper are reported by R. Boothroyd and D. Chapman in "Gender Differences and Achievement in Liberian Primary Children," accepted for publication in the International Journal of Educational Development.

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teachers. The approach offers a means for content to be more logically sequenced and presented in a more task-oriented manner (than teacher designed instruction). The method places more responsibility for learning on the pupil than does more conventional teacher-centered instruction.

At the same time, advocates of programmed instruction argue that the method helps improve the equity of the educational experience received by students across population subgroups. The theory and assumptions underlying the programmed instruction approach posit, for example, that differences in the instructional treatment received by boys and girls or by different age cohorts within the same grade level will be minimized. Consequently, programmed instruction appears to be a strategy to both enhance overall student achievement and minimize disparities in student achievement across subgroups.

A recent educational project in Liberia provided an opportunity to test the claim that programmed instruction would (1) improve student achievement and (2) minimize gender and age differences in achievement over more conventional instructional approaches. The Improved Efficiency of Learning (IEL) project, funded by USAID, developed and employed a combination of programmed teaching (grades 1-3) and programmed instructional materials (grades 4-6). Both were designed to instruct primary school students in five areas (reading, English, mathematics, science, and social studies). The selection of content for instruction was based on the Liberian national curriculum. The project cost in excess of $10 million and spanned five years.

During this time, materials were piloted in fifteen schools and were subsequently implemented in 30 additional schools in 1984. A fuller description of the IEL project and the design of the instructional treatment is provided by Kelly (1984a, 1984b) and Harrison and Morgan (1982).

Differences in achievement by gender and within-class age groupings are of particular relevance to instructional design efforts in developing countries. Reasons for this are discussed below.

Gender Differences in Achievement: Evidence from many developing countries, particularly those in Africa, indicates that female school enrollment is disproportionately low, attrition is higher, and that female achievement may lag behind male achievement (Foster, 1985; Adams and Kruppenbach, 1986). One of the factors offered to account for gender disparities in achievement is differential treatment of boys and girls by teachers. Differential treatment is often the result of differing instructional interactions between male and female students and their teachers. This occurs, for example, if boys are given priority over girls in the distribution of textbooks when there are not enough copies for all students. On a more subtle level, it occurs when a teacher calls on males more often than females during class recitation. Evidence suggests, however, that the extent of differential treatment may vary by the content matter being taught. Leinhart, Seewalds, and Engel (1979) found that teachers have significantly more instructional contacts with boys (than girls) in mathematics but that the trend

reverses in reading, with girls having significantly more instructional contact with their teachers than boys. In developing countries, differential treatment often is exacerbated by the strength of traditional distinctions in the social, economic and religious roles of males and females.

Age Differences in Achievement: Early stages in the development of a formal education system often are characterized by wide variations in the age range of students at each grade level. This variation tends to narrow as the educational system matures. The initial wide range reflects two factors. First, in many developing countries the extension of educational access is relatively recent. As schools become available in areas previously unserved, there is a pent-up demand. Parents may enroll their children in early grades regardless of age. With time this demand is met and new entrants are those who enroll as they reach a more "typical" entry age. Second, schools in developing countries tend to be small due to the scarcity of population and the low availability of transportation. Schools serve these students within walking distance. In small schools, the opportunity for ability or age groupings of students within a grade level is limited.

The literature reports a strong positive relationship between age and academic achievement, generally understood to be mediated by the age-related cognitive and psychological development of the child. The wide age range at a grade level may suggest students within a grade level are at different stages of cognitive readiness.

The present study investigated (1) overall achievement differences in mathematics and English between IEL students and those in more conventional instructional treatments, (2) gender differences in mathematics and English achievement, and (3) achievement differences between students under- and over-age for their grade level.

The study was conducted as policy analysis. Results of the study contribute to current policy discussions in the international development community concerning the most appropriate educational investment strategy (1) to encourage student achievement, and (2) to achieve educational equity (Fuller, 1985). Evidence of significant differences in achievement across student subgroups has important implications for educational planning, curriculum design and teacher training in Liberia. Results also have implications for future educational investment decisions of donor agencies concerned with enhancing student achievement.

METHOD

DESIGN: The study was conducted as a secondary analysis of data collected as part of the evaluation of the IEL project in Liberia (Kelly, 1984a, 1984b). The evaluation employed a post-test only comparison of student achievement between the treatment group (IEL) and two comparison groups. One comparison group consisted of Conventional schools, e.g., schools that had not been subject to any specific instructional intervention. The second comparison group, termed Optimal Conventional, included schools

which had participated in a World Bank funded textbook project several years earlier. These schools were believed to still have better instructional materials than were available in the Conventional schools.

SAMPLE: Students who participated in the original evaluation study were all third (N=1254), fourth (N=1042) and fifth (N 874) grade pupils in 45 rural Liberian schools who were present on the day of testing. The present study included only students who completed both the English and mathematics examinations and provided the demographic information (gender and/or age) needed for the analysis. The resulting sample for the analysis of achievement by gender included 1063 third grade, 765 fourth grade, and 629 fifth grade students.

For the analysis of achievement by age students at each grade level were blocked into three groups--under age, average age, and over age--defined as one standard deviation from the mean age (which was 2 years at each of the three grade levels). A random sample of students in the average age group was used in the analysis to keep group sizes comparable. Final sample sizes were, at third grade, 215 for English and 233 for math; at fourth grade, 213 for English and 220 for math; and at fifth grade, 134 for English and 156 for math.

Schools for the IEL project were selected to be representative of the various settings and conditions that typified primary education in Liberia. Conventional schools were selected through an intentional sampling procedure to be similar

in setting and conditions to IEL schools while the Optimum Conventional schools were determined by their prior participation in the earlier World Bank project. All schools in the study were rural. While the study did not employ random assignment of student to schools or schools to treatments, the threat to the internal validity of the study is judged to be minimal for three reasons: (1) large sample sizes reduce sampling error, (2) schools in each of the three groups represent diverse geographical locations, primary tribal influences, and distance from a main road, and (3) possible confounding of grade repetition with age differences was tested and found to be non-significant.

The possible confounding of grade repetition with age was examined since a preponderance of older students might suggest a high repetition rate. This, in turn, would suggest low previous achievement, perhaps indicative of a concentration of lower ability students. To test for possible confounding, test scores of grade repeaters and non-repeaters were compared using analysis of variance. Out of six comparisons, a significant difference was observed only in grade three math. Further, chi square tests indicated no significance differences in the proportion of repeaters across age groupings. These finding supports the claim that differential achievement by age was not due to a higher concentration of repeaters within the older student group.

INSTRUMENTS: Data consisted of student scores on standardized achievement tests at each grade level for English and

mathematics. The tests were developed by the West African Examination Council (WAEC). The tests were constructed to reflect the Liberian national curriculum and were pilot tested prior to their initial use in the IEL evaluation. The internal consistency reliability (KR-20) of the six tests ranged between .84 and .89 and averaged .86. The third grade English and third and fourth grade mathematics tests consisted of 50 items. The fourth grade English and two fifth grade tests contained 60 items each. All items were four-option multiple-choice items. Correlations between students' English and mathematics test scores were .57 in grade 3, .61 in grade 4 and .61 in grade 5.

Content analyses of each test were conducted by independent consultants and indicated the tests possess a high degree of overlap with the Liberian National Curriculum (Kelly, 1984a). On this basis, they were considered appropriate for use across the three instructional settings.

ANALYSES: Differences in student achievement across the three programs and between male and female achievement were tested using a two-way analysis of variance. Differences among students in three age groups were tested using a one-way analysis of variance.

RESULTS

Achievement Differences by Program

Mean achievement scores of males and females by program and grade level are reported in Table 1. Significant differences in

TABLE 1

SUMMARY OF ENGLISH AND MATHEMATICS ACHIEVEMENT
BY GRADE AND PROGRAM

Group	N	English Mean	English SD	Mathematics Mean	Mathematics SD
Grade 3					
C	204	23.82	8.06	22.33	8.42
OC	337	25.29	8.56	20.68	8.80
IEL	552	27.52	8.57	24.76	7.31
Grade 4					
C	219	22.80	11.11	22.29	7.08
OC	240	21.40	9.96	19.26	7.20
IEL	306	23.28	11.70	21.42	8.28
Grade 5					
C	174	25.09	10.13	24.16	9.67
OC	212	26.40	10.72	26.18	7.75
IEL	243	25.20	10.04	27.31	8.57

achievement favoring the IEL schools were found with both the English and mathematics tests (Table 2).

Gender Differences in Achievement

Results of the analysis of variance to test achievement differences across the three instructional treatments and between male and female students are summarized in Tables 2 and 3. The analysis indicated a significant treatment-by-gender interaction in mathematics that was not detected in the original evaluation.

Significant achievement differences by gender were noted at each of the three grade levels in mathematics and in grades four and five in English. The average mathematics achievement of boys was significantly higher than that of girls at all three grade levels. The greatest differences in male and female mathematics achievement occurred in IEL schools, in which boys correctly answered an average of 6.77 more items that girls on a fifty-item test. Across the three grades in mathematics, the IEL students' mean achievement averages 11.9 percentile points higher than the mean achievement obtained by students in Conventional schools.

Significant differences in English achievement by gender were found in grades four and five. Although the achievement differences by gender in English were not as dramatic as those found in mathematics, the largest gap between boys and girls achievement was again found among students enrolled in IEL schools. Boys answered an average of 2.27 additional items correct, corresponding to a ten percentile point advantage, over girls who took the test. The gender gap in English achievement

TABLE 2

ANOVA SUMMARIES FOR GENDER AND PROGRAM BY GRADE AND SUBJECT

English

Source	SS	df	MS	F	p
Grade 3					
Gender (G)	[illegible]	1	.25	.01	NS
Program (P)	[illegible]	2	1170.03	16.46	.001
G X P	334.15	2	167.08	2.35	NS
Error	[illegible]	1017	71.08		
Grade 4					
Gender (G)	1101.63	1	1101.63	9.04	.01
Program (P)	370.73	2	185.36	1.52	NS
G X P	109.11	2	54.55	.45	NS
Error	[illegible]	759	121.84		
Grade 5					
Gender (G)	240.01	1	240.01	2.02	.01
Program (P)	[illegible]	2	95.58	.90	NS
G X P	1371.77	2	685.89	6.43	.01
Error	[illegible]	615	106.65		

Mathematics

Source	SS	df	MS	F	p
Grade 3					
Gender (G)	4062.25	1	4062.25	62.75	.001
Program (P)	3819.97	2	1909.01	29.50	.001
G X P	395.01	2	197.50	3.05	.05
Error	68430.74	1057	64.74		
Grade 4					
Gender (G)	7031.90	1	7031.90	118.80	.001
Program (P)	600.79	2	300.40	5.76	.01
G X P	241.37	2	120.68	2.04	NS
Error	44926.59	759	59.19		
Grade 5					
Gender (G)	8665.92	1	8665.92	113.56	.001
Program (P)	1298.49	2	649.25	8.51	.001
G X P	702.57	2	341.29	4.60	.01
Error	47542.50	623	76.31		

Source: Boulton-Lewis, R.M. and Chapman, D.W. "Gender Differences in Ethiopian Primary School Children", International Journal of Educational Development. (In Press).

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TABLE 3

MEANS AND N's FOR MALES AND FEMALES BY GRADE AND PROGRAM

	English				Mathematics			
	Male		Female		Male		Female	
	Mean	N	Mean	N	Mean	N	Mean	N
Grade 3								
Conventional	22.71	87	24.64	117	25.20	87	20.13	117
Optimum Conventional	25.11	166	25.46	171	21.70	166	19.61	171
Experimental	28.10	231	27.06	291	27.35	231	22.72	291
Grade 4								
Conventional	23.46	152	21.90	87	24.01	132	19.69	87
Optimum Conventional	23.35	111	19.81	129	23.05	111	16.00	129
Experimental	24.39	160	22.04	138	24.42	164	17.78	138
Grade 5								
Conventional	27.45	96	23.19	78	28.10	96	19.31	78
Optimum Conventional	25.90	119	27.45	93	28.14	119	23.68	93
Experimental	26.97	120	23.46	123	31.90	120	22.83	123

Source: Boothroyd, R.H. and Chapman, D.H. "Gender Differences in Literacy in Primary School Children", International Journal of Educational Development. (In Press).

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was 1.63 items for students in Conventional schools and .44 items for students in Optimum schools.

Age Differences in Achievement

No significant differences in math achievement by age group were found at any of the three grade levels and no significant differences in English achievement were found at grade three (Table 4). However, significant differences in English achievement among age groups were observed at both fourth and fifth grades. At every grade level, under-age students had the highest English achievement, over-age students had the lowest (Table 5). Covariance analyses were conducted to control for program differences. However, the pattern of results did not change.

In summary, the study yielded three primary results: (1) Students in schools which employed programed instruction had a significantly higher level of achievement than students in the other two modes of instruction, though the effect size was small. (2) In general, boys out-performed girls in both mathematics and English with the greatest gender differences in achievement occurring in the IEL schools. (3) At every grade level, under-age students had the highest English achievement, over-age students had the lowest.

DISCUSSION

The IEL program appears to have improved student achievement but, in doing so, it also increased the disparity

TABLE 4

ANOVA SUMMARIES AGE BY GRADE AND SUBJECT

English						Mathematics					
Source	SS	df	MS	F	p	Source	SS	df	MS	F	p
Grade 3											
Age	261.20	2	130.51	1.09	NS	Age	39.70	2	19.85	.25	NS
Error	14441.48	211	69.07			Error	18402.71	230	80.01		
Grade 4											
Age	3168.74	2	1584.87	12.43	.001	Age	16.03	2	8.01	.10	NS
Error	26762.63	210	127.44			Error	17603.49	217	81.12		
Grade 5											
Age	1461.04	2	730.52	6.68	.005	Age	95.11	2	47.56	.56	NS
Error	14654.20	131	109.42			Error	13098.32	153	85.61		

TABLE 5

MEANS AND N's FOR AGE GROUPINGS BY GRADE AND PROGRAM

	English		Mathematics	
	Mean	N	Mean	N
Grade 3				
Under age	27.88	75	23.74	74
At age	26.44	70	24.41	70
Over age	25.20	70	23.42	89
Grade 4				
Under age	27.07	59	22.00	60
At age	23.02	80	21.52	80
Over age	17.42	74	21.32	80
Grade 5				
Under age	28.81	53	26.91	65
At age	23.54	39	26.21	39
Over age	21.19	42	25.10	52

between male and female achievement. The Optimal Conventional group (World Bank textbooks) reduced the disparity in achievement between boys and girls, but at the cost of overall reduced achievement scores for both groups. The effect size associated with the gender discrepancy was small, but the overall effect size associated with the difference in achievement between IEL and comparison groups was also small. To minimize the importance of the gender discrepancy would also challenge the importance of the overall IEL project in improving student achievement. A more appropriate response would be to design programmed instruction in ways that accommodate individual differences (such as gender) known to be important in achievement (Boothroyd and Chapman, in press).

Further, results did not support the expectation that average age students (within each grade level) would demonstrate the highest performance. The finding that under-age students scored better than the average age group raises the possibility that the Liberian primary school curriculum is not well calibrated with the learning readiness of the students. The average age of students in a grade in a developing country is largely a function of political and economic decisions rather than of developmental readiness. These results suggest that Liberian students' cognitive readiness may occur somewhat earlier than they encounter the learning tasks within their present curriculum.

Findings also indicated that older students had lower achievement scores in English. One possible explanation is that

older students have moved beyond the optimal readiness for the cognitive tasks being taught at these grades. The lack of significant differences in math achievement is consistent with previous research which suggests that stages of readiness appear to be more clearcut for verbal/language acquisition tasks that quantitative tasks.

Educators have long recognized the impact of individual learner differences in achievement. One strength of programmed instruction is that once such differences are identified, instructional materials and sequence can be modified to help offset them. The detection of gender and age related differences in achievement does not negate the usefulness of programmed instruction as a teaching strategy. Rather, it provides information essential to the materials revision process. It also underscores the importance of evaluation procedures that examine more than aggregate achievement gain.

In the Liberian case, gender differences in achievement can probably be reduced through the design of programmed instruction that provides special help for female students. Age differences in achievement, on the other hand, relate to how the curriculum is implemented in the schools. It is less an issue of instructional design, more an issue of curriculum implementation. Even well designed materials are no better than their pattern of use. Maximum impact requires that curriculum be aligned with the learning readiness of the students.

Conclusion: Programmed instruction has been advocated as a means of compensating for unqualified teachers, thereby enhancing

student achievement. Responsibility for teaching is shifted from the teacher to carefully designed and sequenced materials that guide both the teacher and the student through learning tasks. Programmed instruction also has been suggested as a means of reducing inequities in the instruction received by students. This study suggested a series of individual student differences that instructional developers need to consider in designing programmed instructional materials within a developing country context.

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VIII

Gender Differences and Achievement in Liberian Primary School Children

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Gender Differences and Achievement in Liberian School Children

The expansion of educational access and equity has been identified by many developing countries as a goal for education (cf. USAID, 1984). It is also a goal of the United States' international development efforts (Cieutat, 1981; Adams and Kruppenback, 1986). Although many countries have made significant progress in extending educational access to regions and groups previously underserved, there is concern as to whether increased equity of access (at the point of inputs) results in a more equitable distribution of the educational outcomes.

One issue of particular concern is whether females receive an education comparable to that of males within school systems that have traditionally enrolled primarily male students. The concern is based on economic as well as moral grounds. Research indicates that education is a significant factor in the success of health, family spacing, and rural development projects important to national development, many of which are targeted toward women (Foster, 1985; Adams and Kruppenback, 1986). Unequal educational experiences for women represent a major wastage of human resources and have consequences which developing countries can ill afford. However, there is considerable evidence, both in the literature and in the experience of technical assistance personnel in developing countries, that girls frequently have lower achievement scores and higher attrition from formal schooling (Foster, 1985;

Armitage, Gomes, Harbison, Holsinger and Leite, (1985).

Three factors have been offered to account for gender differences in achievement: (1) differential treatment of boys and girls by teachers, (2) differential socialization, and (3) inherent gender differences in intellectual functioning.

Differential treatment is often the result of differing interactions between male and female students and their teachers. This occurs, for example, if boys are given priority over girls in the distribution of textbooks when there are not enough copies for all students. On a more subtle level, it occurs when teachers call on males more frequently than females during class recitation.

Differential treatment of boys and girls by teachers may be particularly pronounced in developing countries due to the historical role of women in many of those settings. However, differential treatment is not limited to those settings. Research has found that American teachers have more frequent interactions with male students than with female students (Bean, 1976; Good, Sikes, & Brophy, 1973; Levy, 1972). Furthermore the evidence suggests that the extent of differential treatment varies by the content matter being taught. Leinhart, Seewalds, and Engel (1979) found, through systematic observation of teachers' classroom behavior, that teachers have significantly more instructional contacts with boys than with girls in mathematics. They found the trend reversed in reading, with girls having significantly more instructional contacts with their teachers than boys.

Differential socialization refers to the greater

encouragement parents give male children to participate and succeed in specific endeavors. Maccoby and Jacklin (1974) indicate that the socialization experience is more intense for boys than girls because parents "more strongly discouraged sex-inappropriate behaviors in sons than daughters" (p. 328). Differences in home pressures on male and female children may effect their school work. For example, in developing countries this occurs when girls are expected to help with family chores during times that boys are often free to study or when girls are held out of school on market day to assist their mothers while boys attend class. Evidence also suggests that parents have lower educational expectations for daughters, particularly in traditionally male dominated subjects such as mathematics and science (Levine, 1976; Casserly, 1976). For example, Fox (1976) found that parents are less likely to notice and encourage mathematical abilities in daughters than sons.

Research on inherent gender differences in intellectual attainment between male and female students has focused on the pattern of differential achievement between males and females observed primarily in mathematics (Lockheed, Thorpe, Brooks-Gunn, Casserly, and McAloon 1985). Some studies imply that higher achievement scores attained by male students relate to innate differences between male and female children in mathematics aptitude. Fennema and Sherman (1977) suggest, however, that when differences in coursework between male and female students are removed, gender-related achievement differences disappear. Further, recent reviews of research on gender differences in achievement have found that those

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differences have not held up and that innate differences in mathematics ability between boys and girls is not a viable explanation for differences in attainment.

Although both differential treatment of boys and girls and differential socialization may contribute to gender differences in achievement, the possibility of modifying the instructional interactions in the classroom is the most promising short-term intervention available to educational program planners in developing countries. Altering patterns of differential socialization requires a longer term strategy extending beyond the purview of most project designs.

One effort to standardize the educational treatment received by students across different population subgroups, schools, and localities has been the use of programmed teaching and programmed instructional materials. This approach employs highly structured curricular materials in an effort to equalize the instructional treatment and classroom interactions experienced by students. The approach offers a means for content to be more logically sequenced and presented in a more task-oriented manner than teacher designed instruction. The theory and assumptions underlying this approach posit that the greater specificity of classroom activities and content coverage will help standardize the educational experience across learners and settings. Among other things, the approach should minimize differences in the instructional treatment received by boys and girls in the same classroom. This, in turn, should help minimize achievement differences by gender.

A recent educational project in Liberia provided an

opportunity to test the claim that programmed teaching and programmed instructional materials could improve student achievement over more conventional instructional approaches and at the same time minimize gender-related achievement differences. The Improved Efficiency of Learning (IEL) project funded by United States Agency for International Development (USAID) developed and employed a combination of programmed teaching (grades 1-3) and instructional materials (grades 4-6). Both were designed to instruct primary school students in five areas: reading, English, mathematics, science, and social studies. The selection of content for instruction was based on the Liberian national curriculum. The project cost in excess of ten million dollars and spanned five years. During this time, materials were piloted in five schools and subsequently were implemented in ten additional schools in 1984. A fuller description of the IEL project and the design of the instructional treatment is provided by Kelly (1984a, 1984b) and Harrison and Morgan (1982).

The present study examined gender differences in English and mathematics achievement in three primary grades in Liberian schools. The programmed instructional treatment (IEL) was compared to two other instructional approaches being used in Liberia to determine the extent to which (1) gender differences in achievement existed in each of the instructional modes, and (2) a highly structured curricular program could minimize gender differences in achievement. It was hypothesized that the existence of any gender-related achievement differences would be minimized in the IEL program because the use of the IEL

materials would serve to ensure that boys and girls received the same instructional treatment.

The study was conducted as policy analysis; the focus was on assessing the extent to which programmed instruction could promote educational equity by minimizing gender differences in achievement. The study contributes to current policy discussions in the international development community concerning the most appropriate educational investment strategy to (1) encourage student achievement (Fuller, 1985), and (2) achieve educational equity. Evidence of significant differences have important implications for educational planning, curriculum design, and teacher training in Liberia. Results also have implications for future educational investment decisions of donor agencies concerned with enhancing students achievement.

DESIGN

Procedure: The study was a secondary analysis of data collected as part of the evaluation of the IEL project in Liberia (Kelly, 1984a, 1984b). The evaluation employed a post-test only comparison of student achievement between the treatment group (IEL) and two comparison groups. One comparison group consisted of Conventional schools, e.g., schools that had not been subject to any specific instructional intervention. The second comparison group, termed Optimal Conventional, included schools which had participated in a World Bank funded textbook project several years earlier. These schools were believed to have better instructional materials than those available in Conventional schools.

Sample: Subjects in the original study (Kelly, 1984a) were all third (N = 1254), fourth (N = 1042), and fifth (N = 874) grade pupils in 45 rural Liberian schools who were present on the day of testing. The present analysis included only students who took both the English and mathematics examinations. The resulting sample included 1063 third graders, 765 fourth graders, and 629 fifth graders.

Schools for the IEL project were selected to be representative of the various settings and conditions that typified primary education in Liberia. Conventional schools were selected through an intentional sampling procedure to be similar to IEL schools. The Optimal Conventional schools were determined by their prior participation in the earlier World Bank project. All schools in the study were rural. Although the study did not employ random assignment of students to schools or schools to treatments, the threat to the internal validity of the study is judged to be minimal for three reasons: (1) large sample sizes reduce sampling error, (2) schools in each of the three groups represent diverse geographical locations, primary tribal influences, and distance from a main road, (3) possible confounding of gender differences, age differences, or grade repetition rates with achievement were tested and non-significant.

Age and repetition rates within grade levels were used as school level proxies of student aptitude. A preponderance of older students would suggest a high repetition rate indicating low previous achievement, perhaps indicative of a concentration of lower ability students. However, research by Chapman,

Boothroyd, and Kelly (1985), using the same data, suggests that the achievement differences are not significantly related to age differences between boys and girls at the same grade level. In addition, for this study, grade repetition was employed as a general indicator of student ability and groups were compared on this variable using an ANOVA. No significant differences were observed. Both of these findings support the claim that differential achievement was not due to age differences, repetition rate, or indirectly, to general ability. Although grade repetition is a crude index of ability, this finding nonetheless lends some support to the claim that males and females were of comparable ability.

Instruments: Data consisted of student scores on standardized achievement tests at each grade level for English and mathematics. The tests were developed by the West African Examination Council (WAEC). The tests were constructed to reflect the Liberian national curriculum and were pilot tested prior to their initial use in the IEL evaluation. The internal consistency reliability (KR-20) of the six tests ranged between .84 to .89 and averaged .86. The third grade English and third and fourth grade mathematics tests consisted of 50 items. The fourth grade English and the two fifth grade tests contained 60 items each. All items were four-option multiple-choice items. Correlations between students' English and mathematics test scores were .57 in grade 3, .61 in grade 4, and .61 in grade 5.

Content analyses of each test were conducted by independent consultants and indicated the tests possessed a high degree of overlap with the Liberian National Curriculum (Kelly,

1984). On this basis, they were considered appropriate for use across the three instructional settings.

Analysis: Differences in male and female achievement scores in English and mathematics were tested using a two-way analysis of variance.

RESULTS

Table 1 summarizes students' English and mathematics achievement by program. Results of the ANOVA to test differences in student achievement across the three instructional treatments and between male and female students are reported in Table 2. Table 3 summarizes student achievement by subject, grade, and program.

TABLE 1

SUMMARY OF ENGLISH AND MATHEMATICS ACHIEVEMENT BY PROGRAM

	English			Mathematics		
	Mean	SD	N	Mean	SD	N
Grade 3						
C	23.82	8.06	204	22.33	8.42	204
OC	25.29	8.56	337	20.68	8.80	337
IEL	27.52	8.57	552	24.76	7.31	522
Grade 4						
C	22.80	11.11	219	22.29	7.08	219
OC	21.40	9.96	240	19.26	7.20	240
IEL	23.28	11.70	306	21.42	8.28	306
Grade 5						
C	25.09	10.13	174	24.16	9.67	174
OC	26.40	10.72	212	26.18	7.75	212
IEL	25.20	10.04	243	27.31	8.57	243

TABLE 2

ANOVA SUMMARIES FOR GENDER AND PROGRAM BY GRADE AND SUBJECT

English						Mathematics					
Source	SS	df	MS	F	p	Source	SS	df	MS	F	p
Grade 3											
Gender (G)	.25	1	.25	.01	NS	Gender (G)	4062.25	1	4062.25	62.75	.001
Program (P)	2340.06	2	1170.03	16.46	.001	Program (P)	3819.97	2	1909.00	29.50	.001
G X P	334.15	2	167.08	2.35	NS	G X P	395.01	2	197.50	3.05	.05
Error	75154.56	1057	71.00			Error	68430.74	1057	64.74		
Grade 4											
Gender (G)	1101.63	1	1101.63	9.04	.01	Gender (G)	7031.98	1	7031.98	118.80	.001
Program (P)	370.73	2	185.36	1.52	NS	Program (P)	600.79	2	300.40	5.76	.01
G X P	109.11	2	54.55	.45	NS	G X P	241.37	2	120.68	2.04	NS
Error	92477.00	759	121.84			Error	44926.59	759	59.19		
Grade 5											
Gender (G)	740.01	1	740.01	7.02	.01	Gender (G)	8665.92	1	8665.92	113.56	.001
Program (P)	191.96	2	95.98	.90	NS	Program (P)	1298.49	2	649.25	8.51	.001
G X P	1371.77	2	685.89	6.43	.01	G X P	702.57	2	341.29	4.60	.01
Error	66439.28	623	106.65			Error	47542.58	623	76.31		

TABLE 3

MEANS, STANDARD DEVIATIONS, AND N's FOR MALES AND FEMALES BY GRADE AND PROGRAM

	English						Mathematics					
	Male			Female			Male			Female		
	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N
Grade 3												
Conventional	22.71	7.28	87	24.64	8.65	117	20.20	8.39	87	20.13	8.45	117
Optimum Conventional	25.11	7.91	166	25.46	8.79	171	21.78	9.15	166	19.61	8.47	171
Experimental	28.10	9.14	231	27.06	8.12	291	27.33	7.69	231	22.72	7.01	291
Grade 4												
Conventional	23.46	12.28	132	21.96	9.34	87	24.01	7.50	132	19.69	6.32	87
Optimum Conventional	23.26	9.65	111	19.81	10.22	129	23.05	6.93	111	16.00	7.44	129
Experimental	24.29	11.84	168	22.04	11.53	138	24.42	9.02	164	17.78	7.64	138
Grade 5												
Conventional	27.45	11.26	96	22.19	8.75	78	20.10	10.52	96	19.31	8.63	
Optimum Conventional	25.50	10.84	119	27.45	10.58	93	20.14	9.49	119	23.68	5.52	
Experimental	26.97	10.40	120	23.46	9.69	123	31.90	9.39	120	22.83	7.77	1

Significant achievement differences by gender were noted at each of the three grade levels in mathematics and in grades four and five in English. The average mathematics achievement of boys was significantly higher than that of girls at all three grade levels. The greatest differences in male and female mathematics achievement occurred in IEL schools, in which boys correctly answered an average of 6.77 more items than girls on a fifty-item test. Though achievement differences were statistically significant, an examination of group means (Table 3) suggests that those differences were not large. To examine the practical importance of these differences, effect size was computed.

Effect size was estimated by subtracting the comparison program mean from the IEL mean and dividing the result by the standard deviation of the comparison program. The resulting value can be interpreted as a Z-score and thus reflects a percentage difference separating the means on the achievement tests. The average test score attained by boys was 32 percentile points higher than the girls' average test score. The gender gap was the smallest (across the three programs) for students attending the Optimal Conventional schools with boys outscoring girls by an average 4.56 items.

Significant differences in English achievement by gender were found in grades four and five. Although the achievement differences by gender were not as dramatic in English as those found in mathematics, the largest gap between boys and girls achievement was again found among students enrolled in IEL schools. Boys answered an average of 2.27 additional items

correct, corresponding to a ten percentile point advantage, over girls who took the test. The gender gap in English achievement was 1.63 for students in Conventional schools and .44 items for students in Optimal Conventional schools.

Significant program effects were found in both English and mathematics achievement in grade three and also in grades four and five mathematics. Scheffe tests were performed on all pairwise comparisons to determine where program differences existed. Results from this analysis indicated that in the third grade, IEL students significantly out-performed students from both comparison groups. At grade four in mathematics, students in the IEL and Conventional schools scored significantly higher than students in the Optimal Conventional group. At grade five, mathematics achievement of IEL students was significantly higher than that of students in Conventional schools.

Across the three grades in mathematics, the IEL students' mean achievement averaged 11.9 percentile points higher than the mean achievement obtained by students in Conventional schools. In the third grade English, IEL students mean achievement was 10.6 percentile points higher than that of students attending Conventional schools.

DISCUSSION

The results of this analysis indicate that, on average across all three grades, students in the IEL program scored 13.5% higher than students in the comparison groups on the mathematics achievement test. On the English test, the scores of students enrolled in the IEL program averaged 5.5% higher

than those of comparison group students. In general, boys outperformed girls in both mathematics and English with the greatest gender differences in achievement occurring in the IEL schools. In short, the IEL program seems to have enhanced student achievement while at the same time increased the gender gap in achievement between boys and girls.

Since the IEL curriculum highly structured teachers classroom activities, it is relatively safe to assume that even if differential treatment of male and female students persisted in the IEL program, it had to be substantially less than those existing in comparison schools where such a structure did not exist. Thus, although the expectation that the use of IEL materials would serve to minimize gender-related achievement differences was not supported by this analysis, it is unlikely that the increased achievement discrepancies found between boys and girls in the IEL program can be attributed to differential treatment by teachers.

The most plausible explanation for the increased gender-related achievement differences in the IEL program is that of differential socialization. As previously discussed, the IEL program increased student achievement by providing an enriched and more intensive learning environment. The improved opportunity to learn is paralleled by increased demands on students, particularly in terms of study time to complete assignments. In Liberia, as in many developing countries, numerous family demands are placed on daughters. These expectations may have limited their ability to take full advantage of the enriched learning environment provided by the

IEL program and may have accounted for their lower achievement gains compared to their male counterparts.

In addition to gender-related achievement differences between programs within each grade level, an increasing discrepancy between male and female achievement was observed from grade three to grade five within each of the three treatments. The increasing disparity in male-female achievement was greatest in mathematics, though still evident in English. One explanation is that, if girls and boys are learning at different rates, differences in achievement carried forward from a previous year are accentuated.

This reanalysis of the IEL student achievement data indicated a significant treatment-by-gender interaction that was not detected in the original evaluation study. The IEL program did improve student achievement but, in doing so, it also increased the disparity between male and female achievement. The Optimal Conventional group reduced the disparity in achievement between boys and girls, but at the cost of overall reduced achievement scores for both groups.

The findings exposed both policy and program design issues. The policy issues concern the tradeoffs between equity and achievement. The results suggest that gender differences in achievement can be minimized by offering low quality instruction. Then neither group does well. Alternatively, overall achievement can be enhanced using the IEL curriculum, but achievement by gender will improve at different rates. If the increased disparity in gender is discounted because the effect size is small, then the efficacy of the overall project

is open to challenge, since the overall achievement gains are small.

The program design issue is that instructional designers need to be cognizant of the possibility that programmed instruction (such as the IEL) may increase variation in rates of achievement among subgroups of students. Instructional designers must either modify the programs or include supplemental activities in an attempt to minimize these differences.

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IX

Evaluation of the Improved Efficiency of Learning (IEL) Project in Liberia, Africa:

Overview and Peculiar Problems

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March 1984

EVALUATION OF THE IMPROVED EFFICIENCY OF LEARNING PROJECT IN LIBERIA, AFRICA: OVERVIEW AND PECULIAR PROBLEMS

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I. OVERVIEW OF THE IEL PROJECT

The Improved Efficiency of Learning project (IEL) is funded by the United States Agency for International Development (USAID) and the government of Liberia and is directed at Liberian elementary schools and their teachers, most of whom have had little if any formal training in the craft of teaching but all of whom carry a critical national responsibility. The IEL is designed specifically as an alternative to other formalized systems of teacher education. The belief is that if effective, it will provide a temporary solution to the delivery of instruction in Liberian schools until such time as institutionally based training for Liberian elementary teachers can be made effectively and efficiently available.

Begun in 1978, the IEL project developed and currently employs a combination of programmed teaching materials (grades 1 - 3 1/2) and programmed instructional materials (grades 3 1/2 - 6) designed to instruct elementary students in five

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content areas: reading, language arts (English), mathematics, science, and social studies. Since the materials for grade six are not scheduled for completion until late 1984, the current evaluation covers only grades 1 through 5. The project has prepared materials in English and mathematics for the first five grades and for science and social studies, grades 3 - 5.

In addition to materials that guide teaching, the IEL system employs short-term formal training (3-4 weeks) and provides supervisory support in materials' use. Development of materials, training, and supervision of project teachers is coordinated out of the project office in Gbarnga, Liberia.

Development of the IEL materials has proceded systematically, and the selection of content for instruction was based on the scope and sequence of the Liberian national curriculum. A series of content reviews and related revisions of the IEL materials are part of the history and cost of the project up to this time ($7,500,000). These reviews have been conducted in order to establish that the materials are representative of Liberia's national curriculum on which they are based.

The national curriculum also provided the scope and sequence in each subject area and grade level for the construction of a set of norm referenced achievement tests which were used as the principal indicator of the learning outcomes of the IEL. These examinations were developed independently by the West African Examination Council's (WAEC) Monrovia office. The examinations were pilot tested and then

used in the 1982 evaluation of the IEL system in grades 1 - 4, a study which involved 15 schools that were reportedly matched on enrollment and average levels of achievement. The schools had been randomly assigned to one of three groups of five: those which would use the materials (IEL), those which would not use the materials but were supposed to receive some additional teacher training and textbooks (Optimum Conventional), and those which would not use the materials and receive no assistance (Status Quo).

II. 1983 EVALUATION METHODS

A. Background

The 1983 evaluation of the IEL began in the middle of things, because the requirements that the study use three groups (IEL, OC, SQ) as well as the WAEC examinations were both inherited from the 1982 evaluation. Despite reservations about the utility of the existing three group design, there was no feasible alternative when I became involved in the effort during the last week of August 1983. There was, however, time to respond to some of the limitations that had surfaced in the 1982 evaluation. These focused on the use of tape recorders for delivering and standardizing testing instructions, an enormous amount of missing data, absence of any data describing the extent of actual coverage of material in any of the three groups, and a set of technical issues centering on the appropriate unit of analysis and the sufficiency of statistical analyses. The 1982 evaluation was sorely limited due to a small and eroded sample size that prohibited strong analysis.

Evaluation planning sessions conducted in Monrovia and Gbarnga during the last week of August and the first week of September 1983 involved participants from the Ministry of Education (MOE), USAID/Monrovia, the WAEC, the IEL project staff, and myself. As a result of these and other discussions, it was decided to abandone the use of tape recorders and to employ trained test administrators; to increase the number of variables that would be measured on student background, teacher characteristics, and school characteristics; and to have the examinations scored by the State University of New York computer in Albany, New York.

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was to insure that procedures were followed and that the conditions of testing were comparable across classrooms and groups.

IEL project staff also developed their own achievement tests for grades 1 - 5 in English and mathematics, and these were administered to the entire sample during a second week of testing after the WAEC testing. Students' item responses were transferred to coding sheets by the WAEC for their examinations and by the IEL staff for theirs. The data sheets were then transoorted to Albany were they were punched onto electronic tape and read into a mainframe computer for scoring and analysis.

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The 1983 external evaluation of the IEL system employed a three group design (IEL, OC, SQ) with 15 schools per group

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The history of educational horse race evaluations is bleak. Most often the horses (programs) finish in a dead heat, a tie; the results show no significant differences. There are numerous reasons why this occurs so frequently, and not the least of these has to do with the nature of the finish line, achievement test scores. As a result of the way norm referenced achievement tests are constructed, the way the items are picked, the results tend to average around fifty percent correct. This type of achievement test is built to differentiate among individual students, not programs or schools.

III. PECULIAR PROBLEMS; OTHER ISSUES

Some of the problems thus far encountered in the IEL evaluation are peculiar to what happens when the evaluand is

5,000 miles away and five hours later on the clock. In addition, there are a set of real evaluation issues that characterize this study, and these ought to be identified and discussed. I want to summarize the peculiarities and then spend time discussing the issues.

I suspect that what's peculiar to one person is ordinary to another. Be that as it may, the following vingettes and events occurred between the last week of August 1983 and the second week of March 1984. Maybe a brief recounting of them will help you come to a clear and rapid understanding of what it's like to do one of these evaluations.

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IV. ISSUES

I have identified a series of issues that I think represent the more generalizable evaluation concerns that have thus far surfaced in this study. For starters I offer the following for consideration.

A. FOCUSING THE EVALUATION

B. HORSE RACE DESIGNS

C. NORM REFERENCED TESTING

D. GENERAL ABILITY FACTORS

E. THE SEARCH FOR STATISTICAL SIGNIFICANCE

F. CULTURAL IGNORANCE

G. INTERNATIONAL PRESSURES AND EXPECTATIONS

H. TECHNOLOGICAL TRANSFER IN DEVELOPING COUNTRIES

A word about each of these issues will probably be sufficient.

A. FOCUSING THE EVALUATION

The present evaluation is in part inherited. It has two important ancestors, namely, the project proposal and the previous evaluator who was consultant to the prime contractor. The fact that the evaluation was designed as a black box study and that it was intended to focus on achievement impacts alone were two results of this geneology. I am not persuaded that any careful assessment of the questions and criteria that were in the minds of the principal audiences that surround this project was completed. I suspect that this, in part, is a reflection of the evaluation requirements that represent USAID and influenced the initial design.

B. HORSE RACE DESIGNS

The history of horse race designs in evaluation is bleak indeed, yet it seems that some continue to try to use them, and further that others in powerful positions in developing countries and federal agencies still think they are imperative to evaluation. Little could be further from my own view of their necessity or utility. The problems of client education that exist in this evaluation are extensive and exacerabated by distance.

C. NORM REFERENCED TESTING

Once again, we discover- the expensive way- that NRT's make it almost impossible to detect meaningful school or program achievement differences in program evaluation studies. Their use in this context is surely doubtable. But what is equally questionable is the construct validity of such measures, not to mention problems associated with content

validity. What we have here is a set of measures that are generally reliable but which possess marginal validity. The issues are both technical and educational. Many in the audiences for this evaluation were rudely misled about what could be expected from a battery of NRT's.

D. GENERAL ABILITY FACTORS

Truman Kelley warned of it in the 1920's: the difference between measures of aptitude and measures of achievement are basically temporal and rhetorical. Most often we cannot tell the measures apart on either logical or empirical bases. The issue in this evaluation resolves to: What's to be done when and inter-battery factor analysis confirms that the four achievement tests in grades 3 through 5 show a single factor solution that accounts for more than 68% of the common variance? (See Table 1, attached.)

E. THE SEARCH FOR STATISTICAL SIGNIFICANCE

Whether I like it or not, generations of my evaluative predecessors have sold a lot of people the language of hypothesis testing and belief in statistical significance. The clients in this evaluation are not familiar with confidence intervals, the ease with which large samples can readily generate highly significant statistical results, the difference between statistical significance and educational meaningfulness, and the difference between effect size and the application of a standard for judging the adequacy of program impact in a developing country.

F. CULTURAL IGNORANCE

I am persuaded that it is impossible for an external

international evaluator to develop a mature understanding of the culture and infra-structure of a nation and the role that education and external support plays in that nation's economy and to do so in two weeks. I am also persuaded that to try to conduct and report an evaluation without such understanding is in the first place risky and in the second, probably unprofessional.

G. INTERNATIONAL PRESSURES AND EXPECTATIONS

Like it or not, people around the world are watching what is happening in the evaluation of the IEL program in Liberia. Members of the World Bank are watching because they have a large textbook project operating in Liberia, a project which, until recently, has been in competition with the IEL. People in the East-West Center are watching because the IEL evaluation results may reflect directly on a report they are completing about programs and evaluations like this one. People in Washington, D.C. are watching because the project is about to be refunded, and they would like to believe that the allocation is supported by evaluation findings.

H. TECHNOLOGICAL TRANSFER IN DEVELOPING COUNTRIES.

The ghost of the ugly American haunts the village schools of Liberia. The fact that the initial proposal and the project language for more than three years spoke of "rural" schools and that such terminology has now been dropped from project documents is symbollic of the problems of technological transfer. Some Liberians argue that all schools in Liberia are basically rural and that it is unwise to suggest to the contrary. It is also true that those who are

upwardly mobile migrate toward the larger cities if not out of the country. One might surmise that a good place to put a project and keep it out of the way is to place it in rural schools.

On what basis ought one believe that DISTAR-like programming and programmed instruction should be effective technologies in a culture such as Liberia's? Furthermore, who taught people in the ministry to rely on NRT's if it wasn't the Brittish and the Americans? Liberian children are paying the price.

The highway of educational innovation in the United States is littered with the bones of expensive projects that appeared successful but which met a common demise as soon as external funding was terminated. Why should we not believe that the same future lies in store for the IEL in Liberia, and that the likelihood of this future has little to do with the findings of external evaluations.

TABLE 1

WAEC TOTAL TEST SCORE CORRELATIONS USING STUDENTS

Grade		Subject: Math	Subject: Science	Subject: Social Studies
1	English	.52 (n=1476)	NA	NA
2	English	.61 (n=1167)	NA	NA
3	English	.57 (n=1032)	.46 (n=1017)	.45 (n=1040)
	Math		.38 (n=1061)	.43 (n=1074)
	Science			.63 (n=1068)
4	English	.61 (n=882)	.47 (n=900)	.40 (n=889)
	Math		.33 (n=907)	.30 (n=909)
	Science			.54 (n=922)
5	English	.61 (n=573)	.70 (610)	.50 (n=587)
	Math		.59 (n=569)	.50 (n=544)
	Science			.53 (n=596)

X

External Evaluation of the Improved Efficiency of Learning Project 1983 - 1984

Preliminary Report Number II - Overall Test Results

Dr. Edward F. Kelly

April 1984

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EXTERNAL EVALUATION OF THE IMPROVED EFFICIENCY OF LEARNING PROJECT

1983-1984

PRELIMINARY REPORT NUMBER II - OVERALL TEST RESULTS

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Dr. Eward F. Kelly

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Education and Human Resource Office

United States Agency for International Development

Monrovia, Liberia

April 15, 1984

EVALUATION OF THE IMPROVED EFFICIENCY OF LEARNING PROJECT

I. OVERVIEW OF THE IEL PROJECT

The Improved Efficiency of Learning project (IEL) is funded by the United States Agency for International Development (USAID) and the government of Liberia and is directed at Liberian elementary schools and their teachers, most of whom have had little if any formal training in the craft of teaching but all of whom carry a critical national responsibility. The IEL is designed specifically as an alternative to other formalized systems of teacher education. The belief is that if effective, it will provide a temporary solution to the delivery of instruction in Liberian schools until such time as institutionally based training for Liberian elementary teachers can be made effectively and efficiently available.

The IEL project developed and currently employs a combination of programmed teaching materials (grades 1 - 3 1/2) and programmed instructional materials (grades 3 1/2 - 6) designed to instruct elementary students in five content areas: reading, language arts (English), mathematics, science, and social studies. Since the materials for grade six are not scheduled for completion until late 1984, the current evaluation covers only grades 1 through 5. The project has prepared materials in English and mathematics for the first five grades and for science and social studies, grades 3 - 5.

In addition to materials that guide teaching, the IEL

system employs short-term formal training (3-4 weeks) and provides supervisory support in materials' use. Development of materials, training, and supervision of project teachers is coordinated out of the project office in Gbarnga, Liberia.

Development of the IEL materials has proceded systematically, and the selection of content for instruction was based on the scope and sequence of the Liberian national curriculum. A series of content reviews and related revisions of the IEL materials are part of the history and cost of the project up to this time. These reviews have been conducted in order to establish that the materials are representative of Liberia's national curriculum on which they are based.

The national curriculum also provided the scope and sequence in each subject area and grade level for the construction of a set of norm referenced achievement tests which were used as the principal indicator of the learning outcomes of the IEL. These examinations were developed independently by the West African Examination Council's (WAEC) Monrovia office. The examinations were pilot tested and then used in the 1982 evaluation of the IEL system in grades 1 - 4, a study which involved 15 schools. The schools were assigned to one of three groups of five: those which would use the materials (IEL), those which would not use the materials but were supposed to receive some additional teacher training and textbooks (Optimum Conventional), and those which would not use the materials and receive no assistance (Status Quo).

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IV. ISSUES THAT MUST CONSTRAIN THESE RESULTS

A. Norm Referenced Tests (NRT's)

There are serious issues that constrain the results of this evaluation, at least as the results are known at this time. Not the least of these issues concerns the purpose and technical character of norm referenced tests, those that were developed by the WAEC as well as the IEL project. The purpose of such measures is to differentiate among individuals, and it is to this end that such test items are developed, analyzed, and judged useful.

Unfortunately, due to the way they are constructed, norm referenced tests are most often insensitive to the effects that evaluations of programs and schools are interested in detecting. The use of norm referenced tests makes the task of detecting meaningful differences between the IEL, OC, and SQ groups extremely difficult, so difficult that there is reason to believe that some test effects may be the result of fluctuations in sample, missing data, or other artifactual conditions.

The items that constitute such tests are usually chosen

because of their ability to tap what is being tested and also because they are likely to discriminate between students who know the information and those who don't. As a result, the classic item for a norm referenced measure tends to average around fifty percent difficulty and discriminate between the upper and lower halves of the total test score distribution. As a result, many norm referenced measures that are well developed tend to produce average scores correct around fifty percent.

Furthermore, due to the purpose of the measures and the nature of the items, norm referenced tests do not permit us to say what children can actually do. They are meant to be interpreted with respect to the observed mean, the average score, or against an external norm derived from a comparison group. Instructional programs such as the IEL are intended to produce learning outcomes tha can be interpreted as skills, competencies, and knowledge, not to mention attitudes. It is precisely these skills and knowledges that cannot be readily discerned in the interpretation of norm referenced tests. Unfortunately, what happens is that in the search for strong items that will discriminate among students, the content of test items is sacrificed for greater discriminability.

Norm referenced tests are designed to measure constructs such as verbal ability, manual dexterity, or mathematics achievement. But schools don't teach these things. For example, schools teach children the number facts, how to identify and safe-guard certain tools, and basic vocabulary. Schools and academic programs don't teach

achievement; that's a construct that test makers attempt to model and measure.

B. Content Validity of WAEC Tests

In addition to the conceptual problem related to the purpose of norm referenced measures, serious questions need to be raised about the extent to which the content of the items on the WAEC and IEL examinations is a fair representation of the content of the IEL instructional materials. In order to estimate the match between what the WAEC items asked and what the materials contained, an independent set of raters analyzed the tests and IEL modules. Results of that analysis are summarized in Chart 1, and they lend credence to the following: There is wide variation in the goodness of fit between the WAEC test item content and the instructional content of the IEL materials. This match ranges from a low of 26% valid items in grade five social studies to a high of 87% valid items in grade one mathematics.

Pursuing this analysis, we examined the extent to which performance of the IEL group may have been related to the frequency of valid items on the WAEC examinations. In a sense the hypothesis was that if the items had been appropriaterly categorized, and if the IEL materials were actually implemented in classrooms (something about which we have little knowledge), IEL students would do better on those tests which showed the strongest item fit to the IEL materials. Arbitrarily, we defined strong fit as tests which contained at least 75% valid items. Four such tests were identified:

CHART 1

FREQUENCY OF ITEM INVALIDITY

Grade Level	Subject			
	English	Math	Science	Social Studies
1	9*/45(20%)	4/30(13%)	-	-
2	18/45(40%)	11/45(24%)	-	-
3	12/50(24%)	20/50(40%)	14/40(35%)	**
4	34/60(57%)	22/50(44%)	21/30(70%)	22/43(51%)
5	**	42/60(70%)	20/50(40%)	37/50(74%)

* Number of items judged invalid for IEL materials.

** Missing this analysis.

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English 1 (80% valid), Math 1 (87% valid), Math 2 (76% valid), and English 3 (76% valid). Analysis of the results in these four testing areas showed no pattern in support of this hypothesis. In fact, in English 1, Math 1, and Math 2 both SQ and OC groups tended to do better than the IEL students. There were no differences in English three.

Both the WAEC examinations and the IEL materials were constructed from the national curriculum. As a consequence, it was hoped that the WAEC tests and the IEL instructional materials would bear a considerable overlap. In an effort to understand how well the WAEC tests matched the national curriculum, we conducted an analysis of the curriculum against the WAEC test item content in science, grades three through five. We chose science because it is not one of the areas assessed by the IEL examinations and because the possibility for agreement between item content and curricular content seemed somewhat easier to attain in science than it might be in social studies.

Each test item was analyzed to determine if it asked students about a content element contained in the national curriculum's scope and sequence. If the item did, it was judged curricularly valid. Each item was then examined for its relationship to the activity outlines in the national curriculum. The belief was that content that is exemplified in actual activities for teachers to use stands a better chance of being implemented in the classroom. If the item contained such information, it was judged instructional valid. The number of items on each of the three tests that possessed both

curricular and instructional validity were then summed. Lastly, we examined the match between the test items and the scope and sequence of the units in science at the three grade levels. The belief was that the item content should sample the entire scope of the units.

There are 40 items on the WAEC third grade science test. Thirty-seven of these tested content from the scope and sequence outline. Thirty-three also tested content from the acitivities outline, and there was an overlap of 32 items which satisfied both criteria. All units in the scope and sequence were represented, but unit 4 was over-represented. Fifteen of the 40 questions on this test are drawn from one unit.

There are 30 items on the fourth grade science test, and only seven of these test content that appears in the curriculum. Only two of the 30 items reflect content from the activities outline. Of the 21 units that make up the fourth grade science curriculum, 16 are not represented on the test.

Forty-seven of the 50 items that constitute the fifth grade science test were judged curricularly valid, and of these, 31 possess instructional validity. Items 36, 47, and 48 lack both curricular and instructional validity. Units 6, 7, 8, 10, and 12 are not represented on the test.

We concluded that the third grade examination was probably the strongest of the three, and that the science four test is measuring something that has absolutely no bearing on the national curriculum. The science five exam is in better shape, but it, too, should be revised to improve its

representation of the units that make up the fifth grade curriculum.

C. Content, Curricular & Instructional Validity

Traditional conceptions of content validity portray it as the extent to which a sample of items is judged representative of a larger domain of potential items from which they were drawn. This is an important relationship because under the rubrics of classical test theory it is to this domain that we wish to infer, based upon the score that people achieve on the test. There are no strong empirical methods available for testing the representativeness of item samples against the domain they represent. Such analyses are based on logic, and this logic requires an unambiguous definition of what is to be included in the domain to be measured.

The extent to which a test is content valid depends on the relationship between the item sample and the domain. A related issue questions the extent to which a test designed to measure achievement in an academic program contains a representative sample of the content and behaviors specified in the curriculum or course syllabus that defines the far more limited domain to which we wish to infer. For example, there are excellent tests of mathematics that would have a different validity when used in schools that do not cover the version of mathematics that the test sampled. Here it could be argued that although the test may be content valid in mathematics, it can be curricularly invalid for a specific school or

educational program.

Lastly, consider the case of an achievement test in mathematics that contains an adequate sampling of the domain and also provides an adequate sample of the content of a specific curriculum. Consider, however, what happens to the validity of that measure if the Math teachers do not teach the curriculum. Suppose they drop the mathematic's curriculum altogether and spend their time entertaining the children. In this instance it could be argued that despite the fact that the test appeared to be content and curricularly valid, it lacked instructional validity. The test measures something that was never taught.

Concerns about instructional validity raise issues of fairness as well as the accuracy of the inferences that may be made from their results. It is unfair to test students across material they never had an opportunity to learn. It is also illogical to make inferences and judgments about academic programs based on achievement test data that are instructionally invalid. Clearly, the presence of instructional invalidity indicates a failure to implement instruction far more than a weakness in measurement. Especially in program evaluations like this one it bears upon us to keep these constraints in mind as we interpret test data. All three considered, content, curricular, and instructional validity bear directly upon the interpretation of the WAEC and the IEL achievement test results.

In addition to content validity, a crucial issue that surfaces in this evaluation focuses on the extent to which

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performance on these examinations may be related to social skills and work related considerations in Liberia. There are many good reasons for educating children, but one of these that can be supposed important to the families of Liberian children questions the extent to which school-based learning can be related to practical applications in the work place. To put the matter bluntly, there is no evidence that performance on these examinations has a predictive relationship to being able to do something that is socially useful. Literacy would be one such outcome. Job relevance is yet another.

Given the frequency of school dropouts, this question would seem important, and it is unfortunate but at this time the evaluation has no evidence for a responsible answer. Technically phrased, we have no data on the predictive validity of either the WAEC or IEL examinations. A worthy addition to future evaluations of programs like the IEL would be to build measures of employability in the modern sector and use them as a portion of the achievement instrumentation.

D. Aptitude & Achievement: A Confusion

Furthermore, there is great difficulty in telling the difference between aptitude and achievement. One of the reasons why the relationship between measures of aptitude and measures of achievement is so high is due in part to the fact that both types of tests may be measuring the same thing. Some would call it previous learning or achievement. Whether such learning has occurred in English, social studies, or mathematics, the effects of it tend to be visible throughout

any test battery. Such would seem to be the case in elementary schools in Liberia where the importance of learning the English language may affect performance on all kinds of tests.

It may, in part, be the result of these confusions between the purpose of norm referenced tests as well as the ambiguity that relates achievement and aptitude that the scores from the WAEC examinations tend to be moderate to high in their correlations with each other.

In order to estimate the extent of this relationship across all four WAEC tests at the same time, the test scores for students in grades three, four, and five were intercorrelated within each grade, and the resulting correlation matrix was submitted to a common factor analysis. The purpose of this statistical technique is to describe the amount of common variation that exists within a correlation matrix. Insofar as tests are measuring the same construct, they should share a high degree of common variation, since tests that measure the same construct ought to relate to each other.

Factor analyses could not be performed on the WAEC tests for grades one and two or on the IEL tests because there were but two tests (English and mathematics). The best estimate of the overlap between two tests is provided by the correlation between their total scores across all three groups. For the WAEC examinations in grades one and two those correlations equal .52 in grade one and .61 in grade two. The corresponding values for the IEL examinations are .57 and .50.

The results of the factor analyses in grades three, four and five were comparable; a single factor solution was developed that accounted for 67%-69% of the common variance among the total test scores. We interpreted this result as supporting the belief that a general construct underlies performance on the four WAEC tests. We have called this factor verbal ability, although others might title it general ability or general achievement.

In an effort to shed light on the nature of this factor, we generated scores on it for each student in the third, fourth, and fifth grades for whom there was complete data. These scores are similar to standard scores. They have a mean of zero and a standard deviation of one, and they tend to be normally distributed. In order to estimate whether students in the three programs differed meaningfully from each other on this factor, a series of analyses of variance were conducted within each of the three grade levels. Results of those analyses showed a statistically significant ($p. < .05$) although slight difference in favor of the SQ students in grade three, and no differences in grades four and five.

At this point we were undecided whether the result in grade three should be interpreted as evidence in support of the belief that children in the grade three SQ group had, for some unknown reason, developed better verbal skills than had members of the IEL and OC groups. In order to examine this hunch further, we looked closely at the test comparison results for grade three and found that SQ students tended to outperform the other groups in both mathematics and social

studies, and that these results appeared to be stable in both univariate and multivariate analyses. In other words, the difference in the factor score distribution that was observed in favor of the SQ students was also visible in the results of the SQ students in two out of the four subject areas tested. This finding, however, was not interpreted as evidence in support of the claim that the underlying construct in the WAEC tests is verbal ability. It simply reconfirmed the fact that there is a strong general factor present in the measures.

To estimate how strong that factor is, we examined how it related to achievement in all three grades in a series of regression analyses in which the factor score was used to predict the total score correct on each of the achievement tests. Results of these analyses showed that once the factor score entered the analysis, other variables, namely, student sex, age, and program were unable to add any additional power to the prediction of achievement.

The consistency of the factor analytic reductions across the third through fifth grade results foretold what we would discern in these analyses. For example, it is important to remember how comparable those factor solutions were in three different grade levels of students. Secondly, it is important to remember that when the factor scores were computed for students, those scores represented either the verbal ability or general achievement of the children. To then use these scores in an effort to predict the remaining variance in achievement that was still left in the total test scores in grade four English, for example, sets up one of the

most demanding, if not most naive analyses permissible. It is not surprising that program participation is unrelated to achievement after the effect of the factor score has been taken into account.

We pursued the meaning of the general factor embedded in the WAEC tests through one additional analysis. The IEL achievement tests in English and mathematics had not been included in the factor analyses, and we hypothesized that if the factor that we had uncovered represented verbal ability, its correlation with the IEL English score would be higher than its correlation with the IEL mathematics score. Results of this preliminary analysis showed that the correlation between the factor score from the WAEC exams and the total score correct on the IEL grade four English test is .60, while with mathematics it is .14. Furthermore, when this factor score is used in an analysis of the IEL results, it predicts 25% of the variation in the fourth grade English scores and 9% in mathematics.

With repsect to the WAEC examinations there are good reasons to believe that they are not well matched to the content of the IEL curriculum, and further that there is evidence that some of the examinations, such as science four, bear hardly any relation to the national curriculum. Analysis of the examinations in grades three, four, and five shows a strong underlying factor that accounts for as much as 68% of the covariation among the tests, and it appears that this factor may represent the verbal ability of the students far more than it represents academic achievement of the knowledge

and skills that are supposed to be learned by elementary school children in Liberia.

E. Measuring the Level of Implementation of Materials

Yet another major technical problem prefaces the findings of this evaluation as of this date. This problem focuses on the level of implementation that describes the extent to which instructional materials were employed, and the extent to which the teacher training that was administered to IEL and some OC teachers affected their in classroom behaviors, and one wonders, the consequent achievement of their students. For example, a failure of implementation, with or without effective teacher training could, in and of itself, prohibit the IEL from demonstrating its effectivenenss even if its instructional materials were of the highest quality possible. There can be no effects from materials that are not used or not used appropriately. The best indicator currently available with respect to implementation is the report of IEL teachers on the maximum number and level of modules that they said they covered. There is, however, no evidence on how well they covered the materials or how well their students used them.

It is already clear that future evaluations of this program will have to spend far more resources monitoring the level of implementation of materials in classrooms. This problem has been pointed out in earlier documents and criticisms of the IEL evaluation design, but now it is time to do something about it. Effective methods for measuring with

reasonable accuracy levels of program implementation are available and should be used.

Absent evidence on implementation, a good argument can be made that insofar as IEL teachers did not implement the materials appropriately, there exist few, if any, meaningful differences between what happened in IEL, OC, and SQ classrooms. If this were true, one would expect the resulting achievement levels across these three groups to assume a random distribution reflective of ideosyncratic effects. To put the issue differently, absent effective implementation of the IEL, and excepting the training and textbooks that OC classes recently received, there really are no group comparisons to be made since all the groups ought to perform in equivalent fashions. Observed differences should be nonsystematic.

F. Summary of Constraints

In summary there are a set of important conceptual and techincal issues that constrain the findings about to be reported. These include the following:

1. The use of norm referenced tests as measures of academic program and school effectiveness is ill-advised because the tests are not constructed for such purposes.

2. Conceptual confusions between the meaning of achievement and aptitude make the interpretation of norm referenced test battery results difficult.

3. Medial to high degrees of correlation between different tests within the same battery suggests that the

tests may be measuring a common construct rather than specific subject matter effects.

4. Weak representativeness between the items that make up a test and the domain that the items are supposed to represent challenges seriously the argument that the tests are content valid.

5. Weak representativeness between the items that make up an achievement test and the content of the curriculum in which it is used challenges the argument that the test is valid for that curriculum.

6. Failures to implement an instructional program systematically alter the validity of achievement tests, since students cannot be expected to learn academic content that they were never taught or given an opportunity to learn.

V. OVERALL SUMMARY OF FINDINGS

Overall results for the entire sample on both the WAEC and IEL examinations appear in Table 1. On the WAEC tests the mean percent correct ranged from a high of 77% (Math. 1) to a low of 37% in Social Studies 4. A ceiling effect is noted in Math 1. Apparently the children know more mathematics than this test assesses. The reliability of the WAEC Science 4 examination (.62) is unacceptable for tests of this type, and this reflects the results of the analysis of the validity of the WAEC tests in science. At this point it is clear that the WAEC grade four science examination is neither valid nor reliable. In simple terms a reliability coefficient of .62 means

TABLE 1

WAEC EXAMS OVERALL RESULTS

Grde.	Subj.	No. Items	N	X	S.D.	%Correct	KR-20
1	Eng.	45	1773	23.3	9.23	52	.88
1	Math.	30	1793	23.2	6.00	77	.86
2	Eng.	45	1373	22.6	9.28	50	.89
2	Math.	45	1468	28.3	8.63	63	.88
3	Eng.	50	1190	27.8	8.63	56	.84
3	Math.	50	1254	25.8	9.13	52	.86
3	Sci	40	1280	20.8	5.73	52	.73
3	Soc.St.	48	1300	25.8	7.46	54	.81
4	Eng.	60	1033	24.4	11.13	41	.89
4	Math.	50	1042	22.0	8.01	44	.83
4	Sci.	30	1021	12.6	4.17	42	.62
4	Soc.St.	43	1029	16.1	5.70	37	.71
5	Eng.	60	874	27.1	10.89	45	.88
5	Math.	60	827	28.8	9.83	48	.86
5	Sci.	50	835	23.8	7.74	48	.81
5	Soc.St.	50	824	23.0	7.79	46	.81

IEL EXAMS OVERALL RESULTS

1	Eng.	40	1658	30.4	6.00	76	.83
1	Math.	30	1617	20.6	5.46	68	.81
2	Eng.	45	1363	29.8	6.13	66	.77
2	Math.	50	1331	31.2	8.39	62	.86
3	Eng.	51	1309	19.6	6.25	38	.70
3	Math.	50	1188	26.9	8.45	54	.84
4	Eng.	60	1060	28.1	9,04	47	.84
4	Math.	35	1071	14.0	3.97	40	.57
5	Eng.	45	833	22.5	7.43	50	.82
5	Math.	38	843	14.0	5.61	37	.76

that approximately 38% of the variation within the test scores is due to measurement error.

IEL test results in English and mathematics are also summarized in Table 1. The average percent correct ranged from 37% in Math. 5 to 76% in English 1. No ceiling effects were detected, but the reliability of the IEL Math. 4 examination (.57) is unacceptable.

In general the mean percent correct tends to drop across the five grade levels. For example:

MATH

Mean Percent Correct at Grade Level

	1	2	3	4	5
WAEC	77	63	52	44	48
IEL	68	62	54	40	37.

More illuminating comparisons, however, appear in Table 2 were the average percent correct for all three groups at each grade and subject level are reported. Table 2 presents a summary of the principal findings of the evaluation with respect to differences among the achievment performance of the three groups.

Table 2 summarizes the results of 26 comparisons that related the performance of the three groups against each other. In seven of the comparisons the difference between the means of the three groups was so small that it was not reasonable to assume that the differences were trustworthy. These seven comparisons are marked N.S.D. for non significant difference ($p > .05$). In the other 19 comparisons reliable differences separate two or more of the groups, and these are indicated in the right hand column of Table 2.

TABLE 2

PERCENTAGE CORRECT RESULTS FOR ALL GROUPS ALL TESTS

Test	Grade	Subj.	No. Items	Percent Correct IEL	OC	SQ	Difference (p <.05)
WAEC	1	Eng.	45	49	53	56	SQ & OC > IEL
IEL	1	Eng.	40	80	70	78	IEL > OC & SQ
WAEC	1	Math.	30	77	77	80	SQ > OC
IEL	1	Math.	30	73	60	70	IEL > OC & SQ
WAEC	2	Eng.	45	51	56	42	OC > IEL > SQ
IEL	2	Eng.	45	71	64	62	IEL > OC & SQ
WAEC	2	Math.	45	60	67	60	OC > IEL & SQ
IEL	2	Math.	50	66	60	60	IEL > OC & SQ
WAEC	3	Eng.	50	56	56	56	N.S.D.
IEL	3	Eng.	51	39	39	37	IEL & OC > SQ
WAEC	3	Math.	50	48	50	58	SQ > OC & IEL
IEL	3	Math.	50	58	50	52	IEL > OC & SQ
WAEC	3	Sci.	40	53	50	53	N.S.D.
WAEC	3	Soc. Stud.	48	52	52	58	SQ > OC & IEL
WAEC	4	Eng.	60	42	42	42	N.S.D.
IEL	4	Eng.	60	52	47	43	IEL > OC & SQ
WAEC	4	Math.	50	44	44	46	N.S.D.
IEL	4	Math.	35	43	40	40	IEL > OC
WAEC	4	Sci.	30	43	40	43	SQ > OC
WAEC	4	Soc. Stud.	43	40	35	37	IEL > OC
WAEC	5	Eng.	60	43	45	45	N.S.D.
IEL	5	Eng.	45	53	49	47	IEL > OC & SQ
WAEC	5	Math.	60	45	48	47	N.S.D.
IEL	5	Math.	38	39	37	32	IEL > OC > SQ
WAEC	5	Sci.	50	46	50	46	OC > IEL
WAEC	5	Soc. Stud.	50	38	46	46	SQ & OC > IEL

Performance of the IEL was superior to that of the OC's and SQ's in 11 of these 19 comparisons, while the OC's were superior in 4, and the SQ's in 6. The number of comparisons sums to more than 19 due to the fact that in some of the comparisons the results for the groups are combined, that is, two groups did better than one other.

It is important to note that the superior performance of the IEL group is closely related to which test form (WAEC or IEL) provided the basis for the comparisons. Ten of the 11 comparisons that show the IEL superior are based on the IEL achievement tests in English and mathematics. I believe this pattern of results speaks directly to the issues related to the validity of the WAEC tests that were discussed in the introduction to these results.

This issue is represented all too clearly in the results in English 1 in Table 2. On the WAEC examination both the SQ's and OC's did better than the IEL. The fact that the SQ's should outperform the IEL group is counter to my logic. On the other hand, results for the same comparison on the IEL examination show the IEL superior to both the OC and SQ groups. Given that both tests possess acceptable reliabilities (see Table 1), one plausible interpretation of these findings is that the tests are measuring different things. At this point is seems safe to assume that the WAEC examinations contain a strong element of verbal ability, and that the IEL examinations are more valid for the instructional program that is being evaluated.

VI. CALCULATING AND INTERPRETING EFFECT SIZE (ES)

A word or two needs to be said about effect size (ES). It is well known that achieving statistical significance is simple when sample sizes are large, as they are in this evaluation. Because of large sample sizes, minute differences between group means frequently yield highly significant statistical results. The question that program managers and policy makers need to be concerned about is not whether the results are statistically significant, but given that the results are acceptably different at some level of confidence, say five out of a hundred, what is the educational significance of the difference? Effect size estimates the strength of the relationship between a treatment, in this case the IEL program, and the achievement outcome that is supposed to be related to it.

Although there are different ways to estimate effect size (ES), in the results that follow ES was calculated by subtracting the mean of the OC group from the mean of the IEL group and dividing the result by the standard deviation of the OC group. This was done in those instances where a statistically significant difference existed with respect to the IEL and OC comparison. In instances in which the only reliable differences were those separating the OC and SQ groups, the SQ's were taken as the control group, and their mean was subtracted from the mean of the OC's. A minus sign is used to indicate any effects that were counter-intuitive; that is, results in which the control group did better than the treatment group such as when the OC's did better than the IEL

or when the SQ's did better than either the IEL or the OC's.

One of the advantages of ES is that it can be interpreted as a percentage under the normal curve. For example, given an effect size of -.26, as in the comparison of the OC's and SQ's reported above, the value, .26, is treated as a z-score and read as a precentage difference that separates the mean of the OC's from the mean of the SQ's on the achievement test. Consultation of a table of values for areas under a normal curve shows an effect of .26 to be equal to 10 percentile points. What this suggests is that if the average performance of the OC group is taken as the fiftieth percentile, the performance of the SQ group would place its mean at the sixtieth percentile on the same achievement test. In this instance the minus sign is used to suggested that the difference was in favor of the control group, in this case, the SQ's. Chart 2 summarizes the percentile transformations for the effect sizes reported throughout these results

VII. SUMMARY OF RESULTS FOR FIRST GRADE

WAEC TEST RESULTS

Results for first grade were analyzed in a multivariate analysis that reduced Wilk's Lambda to .977, (p. <.001) and yielded a canonical correlation of .133. Although the analysis produced a statistically significant result, the significance is due, in part, to the large sample rather than the magnitude of between group differences. This is suggested by the slight

CHART 2

TRANSFORMATION OF EFFECT SIZE INTO PERCENTILE DIFFERENCES

Effect Size	Percentile Difference
.19	7.5
.20	7.9
.22	8.7
.23	9.1
.25	9.8
.26	10.2
.27	10.6
.29	11.4
.31	12.1
.32	12.5
.34	13.3
.35	13.6
.36	14.0
.38	14.8
.41	15.9
.42	16.2
.45	17.3
.46	17.7
.49	18.7
.50	19.1
.54	20.5
.58	21.9
.62	23.2
.64	23.8
.68	25.1
.83	29.6

reduction in Lambda. Comparison of the three programs within the multivariate framework supports the belief that the SQ and OC groups both did better than the IEL in English (Effect Size = -.26 and -.19), and that the SQ students outperformed the OC students in mathematics (Effect Size = -.20).

IEL TEST RESULTS

The IEL tests results for first grade English and mathematics were examined in a multivariate analysis that reduced Wilk's Lambda to .90 (p. <.001) and produced a canonical correlation of .31. Comparison of the performance of the three groups in English showed a significant difference (p. <.001) in favor of the IEL program in comparison to both OC and SQ groups. The effect size relating the IEL against the OC group was .64 and against the SQ's, .26.

Similarly, in first grade mathematics results on the IEL examinations showed superior performance of the IEL (p. <.001) over that of both the SQ and OC groups. The effect size relating the IEL against the SQ's was .25 and against the OC's .62.

VIII. SUMMARY OF RESULTS FOR SECOND GRADE

WAEC TEST RESULTS

Second grade achievement data were also analyzed in a multivariate framework. Results of the analysis of second grade WAEC test data produced a Wilk's Lambda of .93 (p <.001) and a

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TABLE 3

WAEC EXAMS GRADE 1 RESULTS

Subj.	Grp.	X	S.D.	N	Lambda	Rc	F[1]	ES
	SQ	24.63	9.39	449	.97*	.13	11.38*	
Eng.	OC	23.96	9.36	459		(SQ > IEL)		-.26
	IEL	22.18	8.38	672		(OC > IEL)		-.19
	SQ	23.93	5.61	449	.99**	.07	3.96	
Math.	OC	22.82	5.97	459				
	IEL	23.33	6.15	672		(SQ > OC)		-.20

*p <.001
**p <.005
***p <.02

[1]Univariate F for differences between groups.

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TABLE 4

IEL EXAMS GRADE 1 RESULTS

Subj.	Grp.	X	S.D.	N	Lambda	Rc	F[1]		ES
	SQ	30.82	5.24	474	.90*	.31	62.99*		
Eng.	OC	28.31	6.05	460					
	IEL	32.20	5.54	596				(IEL > SQ)	.26
								(IEL > OC)	.64
	SQ	20.89	5.03	474	.99*	.00	64.38*		
Math.	OC	18.45	5.98	460					
	IEL	22.17	4.94	596				(IEL > SQ)	.25
								(IEL > OC)	.62

*p <.001 [1]Univariate F for differences between groups.

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canonical correlation of .25. Examination of the univariate differences in English showed the OC group superior to the IEL and SQ's, and the IEL superior to the SQ's. In mathematics the OC group scored higher than both the IEL and SQ groups.

IEL TEST RESULTS

Multivariate analyses of the IEL second grade data reduced Wilk's Lambda to .89 (p. <.001) and yielded a canonical correlation of .31. Comparison of the group means showed that the IEL students outperformed both the OC and SQ groups (p. <.001) with an effect size relating the IEL against the OC's of .62 and against the SQ's of .68.

In second grade mathematics the IEL also outperformed both the OC and SQ groups (p. <.08) and produced an effect size against the OC's of .42 and against the SQ's of .29.

IX. SUMMARY OF RESULTS FOR THIRD GRADE

WAEC TEST RESULTS

Third grade results were also analyzed within the multivariate framework, and this analysis for students produced a Wilk's Lambda of .89 (p. <.001) and a canonical correlation of .31. Comparisons of the students' performance on the four tests showed a significant difference in favor of the SQ sample over both the IEL and OC groups in mathematics (ES = -.50) and social studies (ES = -.35).

IEL TEST RESULTS

TABLE 5

WAEC EXAMS GRADE 2 RESULTS

Subj.	Grp.	X	S.D.	N	Lambda	Rc	F[1]	ES
	SQ	19.17	8.71	346	.93*	.25	40.47*	
Eng.	OC	24.83	9.78	449				
	IEL	22.54	7.84	479				
							(OC > SQ)	.64
							(OC > IEL)	-.23
							(IEL > SQ)	.38
	SQ	27.22	8.23	346	.99**	.08	11.11*	
Math.	OC	29.63	8.28	449				
	IEL	27.48	8.11	479				
							(OC > SQ)	.29
							(OC > IEL)	-.26

*p <.001 [1]Univariate F for differences between groups.
**p <.002

TABLE 6

IEL EXAMS GRADE 2 RESULTS

Subj.	Grp.	X	S.D.	N	Lambda	Rc	F[1]	ES
Eng.	SQ	28.36	5.92	346	.89*	.31	67.61*	
	OC	28.97	5.58	442				
	IEL	32.44	5.35	480			(IEL > SQ)	.68
							(IEL > OC)	.62
Math.	SQ	30.39	8.87	346	.99*	.06	19.95**	
	OC	29.73	7.82	442				
	IEL	33.01	8.29	480			(IEL > SQ)	.29
							(IEL > OC)	.42

*p <.001 [1]Univariate F for differences between groups.
**p <.08

TABLE 7

WAEC EXAMS GRADE 3 RESULTS

Subj.	Grp.	X	S.D.	N	Lambda	Rc	F[1]	ES
Eng.	SQ	28.45	8.73	278	.89*	.31	<1.0	
	OC	27.85	8.47	323				
	IEL	28.18	8.04	373				
Math.	SQ	29.25	9.49	278			28.53*	
	OC	24.54	9.18	323				
	IEL	24.49	8.00	373			(SQ > OC)	-.49
							(SQ > IEL)	-.50
Sci.	SQ	20.85	5.84	278			<1.0	
	OC	20.44	5.75	323				
	IEL	21.01	3.96	373				
Soc.St.	SQ	27.67	8.17	278			12.44*	
	OC	25.48	7.24	323				
	IEL	24.76	7.24	373			(SQ > OC)	-.27
							(SQ > IEL)	-.35

*p <.001 [1]Univariate F for differences between groups.

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Multivariate results of the IEL tests in third grade reduced Wilk's Lambda to .93 ($p < .001$) and produced a canonical correlation of .23. Comparison of the three groups in English showed that both the OC and IEL groups scored higher than the SQ's ($p < .002$), and the effect size relating IEL against the SQ was .34.

In mathematics IEL students outperformed both SQ and OC groups ($p. < .001$) with an effect size equal to .46 against the OC's.

X. SUMMARY OF RESULTS FOR FOURTH GRADE

WAEC TEST RESULTS

When fourth grade results were analyzed, Lambda was reduced to .96 ($p < .001$), and the canonical correlation was .15. Within this weak result, comparison of the group means suggested that the SQ group did better than the OC's in science, and that the IEL group outperformed the OC's in social studies. The effect size separating the IEL and OC groups in social studies was .36.

IEL TEST RESULTS

Results of the multivariate analysis for the IEL tests in fourth grade were significant ($p. < .001$), and the canonical correlation was .22. Comparison of group performances on the English examination showed a significant difference in favor of the IEL over both the OC and SQ groups ($p. < .001$) with an effect size relating the IEL against the OC's of .45.

TABLE 8

IEL EXAMS GRADE 3 RESULTS

Subj.	Grp.	X	S.D.	N	Lambda	Rc	F[1]	ES
Eng.	SQ	18.87	4.15	316	.93*	.23	6.34**	
	OC	20.47	7.60	413				
	IEL	20.29	6.56	371			(IEL > SQ)	.34
							(OC > SQ)	.38
Math.	SQ	25.74	7.80	316	.98*	.10	32.89*	
	OC	24.57	10.05	413				
	IEL	29.26	6.41	321			(IEL > SQ)	.45
							(IEL > OC)	.46

*p <.001
**p <.002

[1]Univariate F for differences between groups.

TABLE 9

WAEC EXAMS GRADE 4 RESULTS

Subj.	Grp.	X	S.D.	N	Lambda	Rc	F[1]	ES
Eng.	SQ	24.58	10.76	317	.96*	.15	<1.0	
	OC	24.84	10.68	279				
	IEL	24.82	12.01	266				
Math.	SQ	22.86	7.93	317			<1.0	
	OC	21.83	7.55	279				
	IEL	22.30	9.47	266				
Sci.	SQ	13.32	4.36	317			5.45**	
	OC	12.22	3.76	279				
	IEL	12.96	4.13	266			(SQ > OC)	-.25
Soc.St.	SQ	16.27	6.08	317			6.42***	
	OC	15.30	4.77	279				
	IEL	17.01	5.80	266			(IEL > OC)	.36

*p <.001
**p <.004
***p <.002

[1]Univariate F for differences between groups.

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TABLE 10

IEL EXAMS GRADE 4 RESULTS

Subj.	Grp.	X	S.D.	N	Lambda	Rc	F[1]		ES
Eng.	SQ	26.47	8.49	386	.94*	.22	26.47*		
	OC	27.85	7.95	363					
	IEL	31.44	10.13	277				(IEL > SQ)	.58
								(IEL > OC)	.45
Math.	SQ	13.91	3.70	386	.99*	.06	6.00***		
	OC	13.63	3.87	363					
	IEL	14.69	4.22	277				(IEL > OC)	.27

*p <.001
**p <.03
***p <.003

[1]Univariate F for differences between groups.

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Comparisons in mathematics showed the IEL superior to the OC's ($p < .003$) with an ES = .27.

XI. SUMMARY OF RESULTS FOR FIFTH GRADE

WAEC TEST RESULTS

When WAEC results for fifth grade were submitted to a multivariate analysis, Wilk's Lambda was reduced to .92 ($p < .001$), and the canonical correlation was .26. Results of this analysis showed non significant differences in English and mathematics. The OC's did better than the IEL in science (ES = -.23), and the SQ's and OC's both outperformed the IEL in social studies where the effect sizes were -.31 for the SQ's and -.38 for the OC's.

IEL TEST RESULTS

The multivariate F in fifth grade was significant ($p. < .001$), and the canonical correlation was .29. Comparison of the group means showed that the IEL group scored significantly higher than both the OC and SQ groups ($p. < .001$) with an effect size of .32 in comparison to the OC's.

In mathematics IEL students outperformed both OC and SQ groups, and the OC students did better than the SQ's ($p. < .001$). The effect size separating the IEL and OC means was .22, and .83 with respect to the SQ students. The effect size separating the OC's above the SQ's was .54.

TABLE 11

WAEC EXAMS GRADE 5 RESULTS

Subj.	Grp.	X	S.D.	N	Lambda	Rc	F[1]	ES
	SQ	26.67	10.76	152	.92*	.26	<1.0	
Eng.	OC	26.65	9.51	185				
	IEL	26.45	11.04	224				
	SQ	27.55	10.81	152			1.78***	
Math.	OC	29.14	8.45	185				
	IEL	27.43	10.12	224				
	SQ	23.03	7.47	152			3.25**	
Sci.	OC	24.58	6.73	185			(OC > IEL)	-.23
	IEL	22.87	7.42	224				
	SQ	22.60	8.04	152			12.40*	
Soc.	OC	23.37	6.93	185			(OC > IEL)	-.38
	IEL	19.18	11.04	224			(SQ > IEL)	-.31

*p <.001
**p <.03
***p <.17

[1]Univariate F for differences between groups.

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TABLE 12

IEL EXAMS GRADE 5 RESULTS

Subj.	Grp.	X	S.D.	N	Lambda	Rc	F[1]	ES
Eng.	SQ	20.87	7.63	241	.91*	.29	16.29*	
	OC	22.03	7.27	287				
	IEL	24.37	6.93	292			(IEL > OC & SQ)	.32
Math.	SQ	11.69	4.49	241	.99**	.07	13.40*	
	OC	14.13	5.96	287			(IEL > OC)	.22
	IEL	15.44	5.25	292			(IEL > SQ)	.83
							(OC > SQ)	.54

*p <.001 [1]Univariate F for differences between groups.
**p <.04

XII. CONCLUSIONS

Given the evidence, it appears that the IEL is an instructionally effective program when it is assessed against measures that are valid with repsect to it. This finding, when combined with the results observed in studies of enrollment in IEL (they are up almost 71% while teacher/student ratios have remained stable), and the results of Wingam's analysis (there are some cost savings to be achieved by use of IEL materials), would support the continued use and expansion of the materials in elementary schools in Liberia.

Whether or not the same magnitude of effects reported in these results can be reasonably expected if the materials are placed in additional schools, needs to be understood. Clearly, the probability of such depends on a number of factors that are intuitively obvious. First, the materials will have to made available in reasonable numbers and at appropriate times. Second, teacher training in their appropriate use will have to be continued, although at this point there is no evidence that directly supports the relationship between this traininhg and effective classroom use of the materials. Third, adequate supervision of material use in schools will have to be continued. Again, the evaluation has no evidence on the adequacy of supervisory practices currently in place in the elementary schools that used the materials. But there is every logical reason to believe that absent adequate levels of supervision, comparable levels of effect will probably not be

obtained in expansions of the IEL.

XIII. RECOMMENDATIONS

A series of recommendations follow. These are based on my understanding of the results the evaluation up to this time and also on my beliefs about how future studies of this type might be strengthened.

1. That the WAEC and IEL examinations be combined into a single set of test items of known validity and reliability with respect to these materials.

2. That a set of criterion referenced tests be developed for instructional objectives of high priority, and that these tests be used to complement any further assessments of achievement with respect to these materials.

3. That multiple matrix sampling approaches be employed in any future evaluations of these materials in order to cut the costs of assessment without lowering seriously the precision of estimation.

4. That the current three group design be abandoned.

5. That indicators of the attitudes of teachers and students toward both the activities and content of the materials be added to any future evaluations.

6. That more attention be paid to monitoring the process variables that describe the materials in use in classrooms.

7. That an ethnographic study of classrooms that effectively use the materials be conducted.

8. That a set of standards for judging the adequacy of performance of materials and students be developed.

XIV. POSTSCRIPT

The text of this preliminary report was delivered in an oral summary to the Steering Committee of the IEL project in Monrovia, Liberia on April 18, 1984. During this two and a half hour presentation the methods and findings, togetherwith the conclusions and recommendations were summarized, and a copy of the report was distributed.

Questions and suggestions raised at that meeting were helpful indeed. One of the principal suggestions focused on the assumed validity of the IEL examinations as summarized in this report. I had argued at the meeting that since the IEL materials were developed directly from the national curriculum and that since the relationship between the materials and the curriculum had been reviewed and accepted by educators from across Liberia, it made sense to assume that examinations that were developed directly from the IEL materials would also be valid with repsect to the national curriculum.

Although some were willing to accept this assumption, others were not, and as a result, a careful analysis of the relationship between the item content of the IEL examinations and the national curriculum is currently underway.

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MEMORANDUM

TO: Dr. Edwin Tolle
USAID, Monrovia

FROM: Dr. Edward F. Kelly
External Evaluator

SUBJ: External Evaluation of IEL: Present Findings

DATE: April 19, 1984

OVERVIEW

Evidence collected during the 1983-84 evaluation of the Improved Efficiency of Learning project when combined with other results supports the conclusion that:

- IEL is an instructionally effective program that produces achievement superior to conventional classrooms in Liberia.

- IEL enrollment has increased significantly without requiring additional teaching faculty.

- IEL produces meaningful cost savings.

* * *

This memorandum summarizes the current findings of the 1983-84 external evaluation of the IEL as reported in Preliminary Report II: Overall Test Results (50 pp.), April 15, 1984.

TESTING DESIGN:

The design for the evaluation was established before I became the external evaluator in August 1983. Decisions to employ a three group design, (IEL, Optimum Conventional, OC, Status Quo, SQ) to use norm referenced tests, and to pay scant attention to process variables were impossible to alter. I was able, however, to augment data collection so that characteristics of schools, background and ability of teachers, effectiveness of principals, and the extent of material coverage in IEL classrooms were included as variables. The relationship of these variables to achievement will constitute a portion of the final report of this evaluation. In this memorandum I summarize the principal findings of the analysis of the achievement test data which is described fully in Preliminary Report II: Overall Test Results (April 15, 1984).

In November, 1983, achievement tests were administered in 15 IEL, 15 OC, and 15 SQ schools in English, mathematics, science, and social studies across

grades 1 - 5. In grades 1 and 2 only English and mathematics were assessed. Two sets of examinations were employed; 16 developed by the West African Examination Council (WAEC) and 10 developed by the IEL project staff. IEL tests measured achievement in only English and mathematics, while the WAEC examinations covered those areas as well as science and social studies. Testing occurred over a two week period. Responses to the WAEC examinations were transferred to coding sheets by WAEC staff, and the data sheets were sent to Albany, New York, where they were processed by me on a mainframe computer at the State University of New York. The same process was followed for the IEL examinations. The number of children in each grade level for whom there is usable data follows: Grade (1) 1,793; Grade (2) 1,468; Grade (3) 1,309; Grade (4) 1,071; Grade (5) 874; Total = 6,515, and the total data set amounts to more than 2 million key strokes of information. Coding, entry, checking, and analyses of these data have all occurred in the last 90 days.

Both the WAEC and IEL tests are norm referenced measures developed from classical testing theory. Basically, the purpose of such tests is to discriminate among individuals through a ranking of scores. When well developed, such measures permit us to say who scored higher (did better) and where people stand either with respect to the test mean score or some external norming sample. Norm referenced tests answer the question, "Who did better?" They do not, however, let us say much at all about what people can do. As a consequence, interpretations of the total score correct from the tests used in this evaluation do not permit us to say much about the extent to which specific objectives of instruction were achieved by students. Ironically, it is precisely toward this end that both the instructional program and any external evaluation ought to be directed. It is also in this respect that an important difference separates the tests produced by the WAEC from those authored by the IEL staff. The tests authored by the IEL staff show a better capture of the instructional skills and outcomes that the program intended than do the WAEC examinations.

RESULTS:

Results are based on an extensive series of analyses of the technical characteristics of the measures and a set of multivariate analyses across the three groups and two to four achievement tests.

A. Reliability and Validity of the Tests

Fifteen of the 16 WAEC examinations showed acceptable levels of reliability (KR-20). The reliability of the Science 4 examination (.62) was judged unacceptable. Analyses of the validity of the WAEC examinations against the IEL instructional materials showed a wide range of results. Three tests, Science 4, Math 5, and Social Studies 5 showed 70% or more invalid items. Six tests contained between 40% and 57% invalid items, and four contained between 13% and 35% invalid items.

Investigation of the validity of the WAEC items with respect to the IEL instructional materials proceeded systematically. English speaking high school teachers in Monrovia who had graduate level training in measurement

and who had no connection with either the IEL or the WAEC were hired to conduct the analysis under guidelines developed by the evaluator. All tests were reviewed by two raters; their results were compared; differences of opinion were negotiated -- if possible -- and the results were tabulated and sent to the United States for processing. Items were declared invalid by the raters if the test item asked a question or required information that was not contained in the instructional content of the IEL materials. In order for an item to be declared invalid, both raters had to agree. Where there was disagreement that could not be negotiated, the item was accepted as valid. Consequently, the results are possibly an underestimate of the frequency of invalidity of the test item content.

In general the WAEC tests exhibit a poor match against the instructional content of the IEL program. It is argued that this result is due to the ambiguity of the national curriculum from which both the tests and materials were developed independently.

Further analyses of the WAEC examinations showed a medial to high level of cross test correlation, and the presence of a single factor in grades 3 through 5 that accounted for more than 67% of the variance in the correlations. Correlations between the two test batteries in English and mathematics are low to medial, .20 - .50. These results support the belief that the two sets of tests are measuring different constructs, and that as a result, their results are not comparable.

Nine of the 10 IEL tests in English and mathematics show acceptable reliabilities (KR-20). The reliability of the IEL grade 4 Math exam (.57) was judged unacceptable. Since the IEL materials were developed directly from the national curriculum, and since this relationship has been widely reviewed and certified, the item validity of the IEL examinations was assumed, although further analyses are planned to investigate this assumption.

It is unfortunate that time did not permit the construction of IEL tests in science and social studies. To some extent, their absence must limit these findings. It is true, nevertheless, that achievement in English and mathematics are of singular importance to further education and effective citizenry in Liberia.

B. Achievement Differences

Twenty-six separate comparisons were conducted (16 for the WAEC tests and 10 for the IEL tests). In each comparison the average performance of students in the three groups was compared. Seven of the comparisons produced non significant differences ($p > .05$). The IEL was superior to both other groups in 11 of the remaining 19 comparisons, while the OC's were superior in 4, and the SQ's in 6. The number of comparisons sums to more than 19 due to the fact that in some of the comparisons the results for the groups are combined; that is, two groups did better than one other.

The superior performance of the IEL is closely related to which test form (IEL or WAEC) was used. Ten of the 11 comparisons that show the IEL superior are based on the IEL achievement tests in English and mathematics. I believe these results support the conclusion that the WAEC tests are generally invalid as measures of achievement for the IEL instructional program.

The size of the effect for the IEL compared to the mean performance of the OC and SQ groups ranges from 8.7 percentile points to 30. The average effect was 17.3 percentile points, and the median was 16.2. On the average IEL students scored 17 percentile points higher than did the comparison group. If the average score is set at the fiftieth percentile for the comparison group, the IEL group tended to perform at the 67th.

CONCLUSION:

The Improved Efficiency of Learning project is systematically designed to combine programmed teaching and programmed instructional materials, on-going supervision, and three weeks of teacher training annually to bring about an effective interim solution to the problems associated with the presence of unqualified and under-qualified teaching staffs in the elementary schools of Liberia. The project is not intended to replace formal teacher education. What it wants to do is to provide effective instructional materials that can be used correctly by teachers who have themselves received only three weeks of training in how to use them, but who also receive on-going support in their appropriate application. To believe that such an effort ought to be able to demonstrate effects on student achievement that are equivalent or superior to those observed in conventional classrooms might seem to some romantic.

Based on the evidence available, when the IEL system is appropriately implemented and assessed against measures that are valid, it demonstrates achievement outcomes that are superior to those achieved in traditional elementary schools in Liberia. This finding, when combined with other evidence descriptive of the IEL's increased student enrollments as well as its cost savings, clearly supports the continuation and expansion of the program in Liberia.

XI

Horse Races, Time Trials, and Evlauation Designs:

Implication for Future Evaluations of the Improved Efficiency of Learning (IEL) Project

Dr. Edward F. Kelly

February 1984

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HORSE RACES, TIME TRIALS, AND EVALUATION DESIGNS: IMPLICATIONS FOR FUTURE EVALUATIONS OF THE IMPROVED EFFICIENCY OF LEARNING PROJECT

Dr. Edward F. Kelly

SUNY-Albany

February 1984

One of the wonderful things about horse races is that the owners, jockeys, and bettors sometimes make money. The horses tend to be well bred, well trained, and well ridden. Even when we lose our money, we most often walk away from the race track with the belief that horse and rider each tried as best they could and that we just bet on the wrong horse. The current design for the evaluation of the Improved Efficiency of Learning project (IEL) reminds me of a horse race.

Some of the problems encountered when comparing horse races to evaluation designs follow:

(1) In program evaluation we are not out for a good time.

(2) In program evaluation the horses are frequently not well trained (they don't always run straight or take turns well).

(3) The riders are sometimes inexperienced and as a result, they don't give the horse a good ride (educationally).

(4) Sometimes the jockeys don't show up for the race. In the business of racing this usually means that the horse will be scratched, and all the bettors will get their money back. On the educational race track horses are permitted to run without a rider, and nobody ever gets their money back.

(5) Educational race tracks don't run straight or even in good ovals, and they tend to be poorly maintained.

(6) Most of us stand to lose a lot more on the educational race track than we would ever consider betting at a parimutuel window.

There are a set of serious issues that surround the current design for the evaluation of the IEL, a design that has now been implemented in 1982 and 1983. In this paper I argue against further iterations of the current horse race design for reasons I believe are good ones. Also suggested are the rudiments of an alternative design which will strengthen the next evaluation. The evaluation of the IEL does not need another horse race. Enough people have lost enough money on that. What is needed is a series of good time trials that will pit the IEL against itself and suggest how fast it can run.

It is assumed that the current three group design for the evaluation of the IEL was based on some of the following premises:

(1) All evaluations must be comparative in order to be evaluations.

(2) As in research, strong causal claims cannot be made unless there exists a systematically constituted control

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group, the most obvious example existing in the true double blind experiment in which neither the experimentor nor the subjects know who is receiving the experimental treatment. Without such control there is no way to dismiss alternative hypotheses.

(3) USAID evaluation guidelines stipulate the need for a control group when such is available and meaningful.

(4) The contractor believed that building such a design into the evaluation of the project would be both professionally valuable and also responsive to the expectations of USAID, Washington, D.C.

(5) Comparing something to nothing is not illuminating. Thus, the use of both SQ and OC schools provides two differing units of comparison which vary in the level of assistance each has received.

(6) Evaluation scholars recognize the importance and necessity of control groups in both true and quasi-experimental designs. Such is the opinion of Campbell and Stanley who call designs without such controls "prescientific," that is, undesirable and unacceptable even as doctoral dissertations.[1]

The following brief discussion of each of these suggested premises constitutes my argument against the current design as well as against future evaluation policy which would require such.

EVALUATIONS MUST BE COMPARATIVE

(1.1) The first premise is true, since there can be no evaluation without comparison. However, this in no way

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demands control group designs. What is required is the use of criteria and standards that will be employed in judgments about the worth of the program. To put the matter another way, all evaluations must be comparative in judgment, but no evaluation design has to use control groups.

Stake expanded on this point in 1967 when he contrasted relative and absolute comparisons as important to evaluations, but he was not suggesting control group designs.[2] Similarly, Lee J. Cronbach's argument in 1963 pointed out clearly that course evaluations could be conducted and interpreted when the object under study was compared only against itself.[3]

CAUSAL CLAIMS REQUIRE CONTROL GROUPS

(2.1) The second premise is as false as the first is true, but the argument enters deeply into the philosophy of social science. Be that as it may, evaluation is different from research, just as much as it is similar to it. The differences are important here. While research seeks new knowledge, evaluation seeks a judgment of worth. The two activities serve different goals. Further, good noncomparative naturalistic research discovers causal relationships, and no control groups are employed.

EVALUATION GUIDELINES REQUIRE CONTROL GROUPS

(3.1) It is true that USAID evaluation guidelines recently in circulation did require the use of control groups et al.

THE CONTRACTOR BELIEVED CONTROL GROUPS WERE NECESSARY

(4.1) This belief existed at the time the IEL evaluation was designed.

COMPARING SOMETHING TO NOTHING IS NOT ILLUMINATING

(5.1) It is true that studies that compare something to nothing generate little excitement when the treatment produces an effect not observed in the control gooup. One of the problems with the current three group design, however, is that unlike a laboratory experiment, we have little or no knowledge about what is happening in the OC and SQ schools. In a sense we do have a blind design. The evaluation did not look at what's happening in these classes, in these schools.

(6.1) Donald Campbell has long since relented on the suggestion that noncomparative designs are prescientific and consequently useless. Furthermore, Cronbach's most recent text on evaluation supports the view that comparison has a role to play, but only when the comparison group is meaningful in the context of study and with respect to the inference that the evaluation seeks to investigate.* In a line, control groups cannot be called essential to evaluation on any a priori grounds.

Is it possible to argue for importance of the OC and SQ comparisons on practical or political grounds? Even if we grant the point, it is extremely doubtful that the approach would stand against such counter claims as the following:

(1) Unlike a true horse race, there is no common finish line in this evaluation. Even if one could be persuaded that the first three group design employed 15 schools that were adequately matched on size and average achievement levels, there is every reason to believe that they varied on social, ecological, educational, and psychological factors important

to program success. They were in no real sense adequately matched for valid comparisons. Since the sample was then expanded to include an additional 30 schools, 10 more in each group, there is even less reason to believe that the groups and schools within them are in anyway "matched."

(2) Even if one were to believe that the three groups were in some ways comparable, and such is not the case, there is no reason to believe that they are all running for the same finish line or that the finish line is well anchored and not apt to move off just as the horses approach. One of the things that makes the finish line hard to define with any precision exists in the character of the achievement tests which play such a mighty role in the present evaluation. There are serious issues to be considered about the content validity of these measures. I do not allude here to whether or not the tests are a good capture of the national curriculum, or whether they reflect the content of the IEL instructional materials. These are important concerns, but there are also serious issues that could not have been anticipated during the preparation of the examinations. The issues were professionally nascent in 1981 - 1982, and they have but recently become clearer. Consider:

(2.1) Norm referenced tests are developed to discriminate among individuals and to measure <u>constructs</u> such as mathematics achievement or quantitative ability. Basically, norm referenced tests are designed to discriminate between individuals, and they are interpreted against the average score observed or against the scores from some external

norming group. There are serious questions whether such measures ought to be used to compare programs or schools, since that is not what they were designed to do. Furthermore, schools don't teach mathematical achievement, but they often try to teach basic skills in arithmetic. Total scores from norm referenced tests don't support interpretations about the discrete skills, concepts, and understandings that the schools involved in the IEL are trying to teach.

(2.2) Cronbach persuaded me in his theory of generalizability and also in his classic chapter on test validation that the conditions of testing, the characteristics of examiners, and the psyhcological climate of testing are all potential sources of error that can radically alter the warrant of an interpretive inference about the meaning of a set of test data.[5] It is clear that such sources of error exist in the schools that make up the current design.

(2.3) The behaviors that are required by the items on norm referenced achievement tests are not always the same behaviors that students learned in their instructional programs. Even in the case where the content may be the same, the instructed and assessed behaviors may differ widely. This is a serious argument against content validity.

(2.4) Lastly, there are good reasons to believe that the distractors or foils that are used in multiple choice items also alter the content validity of tests, since they can change what the item is testing. Measurement specialists have just begun to worry about how to specify the content and behavior of distractors in such items.

These reservations are not offered as part of an argument against the use of norm referenced testing in future evaluations of the IEL. They are offered as cautions in interpreting the current evaluation results and also as preface to the recommendation of alternatives that could strengthen the IEL evaluation without sacrificing the WAEC examinations.

One last caution before some constructive suggestions. In a very real sense the present evaluation design constitutes not only a horse race but also one that's being run in a fog. Evaluating the IEL against two other groups is like betting on a horse and then not being able to watch it run because the fog rolls in or because we inadvertantly turn away from the track. The current design doesn't tell us much at all about what actually happens during the delivery of instruction in IEL classrooms, although we know more this year than last. If our knowledge about the activities of instruction in IEL classrooms is scant, our understanding of what is happening in the comparison schools is totally vacant. No matter what the comparison of test score means may suggest, we will not be able to say much about how the race was run because we never took the time to watch it happen. We need better data on IEL classroom activities.

I suggest strongly that the three group design be abandoned. Not the least of my reasons is that its costs far outweigh its benefits. I will document in a later paper the direct and indirect costs of the current evaluation design. Suffice it to say here that the decision to implement a three

group desgin for two consecutive years was costly, and in my view, it was not worth the bet.

Here are a few thoughts on how to get away from horse races for awhile and institute a series of time trials that will be fairer and less expensive.

(1) The IEL is a living, breathing, natural experiment in action. The program contains all the natural variation in level of treatment that anyone could desire for a strong evaluation. Such variation ought to be capitalized. The three group design should be abandoned and in its place should be instituted a strong, carefully designed, process-product study of the activities and effects of the IEL program in practice.

(2) Questions of comparison, one program against another, and related considerations about effect size should be replaced by the development of a series of standards against which progress in the IEL can be judged. Procedures for developing such standards are well described in available literature, and they answer an important question, "How much is enough?" I find no instance where that question has been raised about the IEL. Given the current design, suppose one of the three groups does better than the other two. Suppose, however, that all three groups performed poorly. What kind of an achievement is it to win one of slowest races ever run? The point is that in a redesigned evaluation serious attention ought to be paid to the identification of different types of standards that can be used to answer an important question, "Is this level of achievement accceptable, given the

conditions of instruction, this program, and this society?"

(3) A modified matrix sampling approach ought to be employed to cut drastically the time and costs of instrument administration while at the same time maintaining the precision of inference desired of the evaluation. By creating short randomly generated tests and then randomly assigning them to students in classes, we will be able to maintain the precision of inference about achievement on the WAEC examinations and also reduce testing time and expense drastically. For example, in the current design two weeks of class time were totally devoted to the administration of achievement tests. All students took all their grade level tests *in toto*. Application of matrix sampling will permit the evaluation to estimate the average scores correct of classes but will not require that all students answer all the questions on all the tests appropriate to their grade level. Students would be asked to respond to far shorter test forms.

(4) No effort whatsoever has been made to monitor student or teacher attitudes or beliefs about the IEL. There simply wasn't time. Next time around the track the evaluation planners ought to make time and do so efficiently through a matrix sampling approach to instrumentation, item selection, and administration.

(5) Where specific skills and behaviors are deemed important enough, some criterion referenced measures ought to be adopted or developed and used as part of the matrix approach to measuring both processes and effects. Criterion referenced tests require the clear statement of a specific

skill or understanding and the specification of a prestated standard of acceptable performance. They are most useful when the learning outcomes are clearly understood and are also important. Unlike norm referenced tests, criterion referenced tests permit us to say whether a sample of students can actually perform a certain skill.

The alternatives put forth above are directed at an effective evaluation design. While these options constitute a creative resolution to a set of complicated design problems in the IEL evaluation, they also speak to the larger concern of providing USAID information necessary to the fulfillment of its mandate while maintaining cost and program efficiency.

FOOTNOTES

[1]D.Campbell & J. Stanley, "Experimental and Quasi-Experimental Designs in Educational Research." In: N.L. Gage (ed.), Handbook of Research on Teaching, Rand McNally, 1963.

[2]R.E. Stake, "The Countenance of Educational Evaluation." Teachers College Record, Winter 1967.

[3]L.J. Cronbach, "Course Improvement Through Evaluation," Teachers College Record Fall 1963.

[4]L.J. Cronbach, Designing Evaluations of Educational and Social Programs. Jossey-Bass, 1982.

[5]L.J. Cronbach, "Test Validationj." In: R.L. Thorndike (ed.), Educational Measurement, ACE, 1971.