DOCUMENT RESUME

ED 069 152 EM 010 565

TITLE	Progress Report for the Instructional Management System. Technical Memorandum.
INSTITUTION	Southwest Regional Educational Lab., Inglewood, Calif.; System Development Corp., Santa Monica, Calif.
SPONS AGENCY	National Center for Educational Research and Development (DHEW/OE), Washington, D.C.
BUREAU NO	BR-6-2856
PUB DATE	10 May 68
NOTE	132p.; SDC-TM-3298/004/00
EDRS PRICE	MF-$0.65 HC-$6.58
DESCRIPTORS	*Computer Assisted Instruction; Criterion Referenced Tests; Curriculum Development; *Elementary School Students; Individualized Instruction; *Instructional Systems; Instructional Technology; *Program Descriptions; Program Evaluation
IDENTIFIERS	IMS; *Instructional Management Systems

ABSTRACT

A progress report describes the design and demonstration of the computer-based Instructional Management Systems (IMS) for the period March 1, 1967, through February 29, 1968. The rationale and design considerations of IMS, development of its system components, functioning of the components during the first field trial, and data collected during the first field trial are discussed. In IMS, teachers administer frequent tests, which are keyed to behaviorally defined objectives and printed on machine readable forms. Data input procedures transform pupil responses for computer analysis, and the computer-generated report contains an analysis of pupils' achievement of objectives and suggests remedial exercises for those who do not meet the criterion performance level. (JY)

TM-3298/004/00

Progress Report for the Instructional Management System

[illegible]

TM-3298/004/00

ED 069152

TECHNICAL MEMORANDUM

(TM Series)

The research and development reported herein were performed pursuant to contract dated 16 June 1966 with the Southwest Regional Laboratory for Educational Research and Development, for a Computer-Based Educational System.

Progress Report for the

Instructional Management System

Instructional Management System
Project Staff

10 May 1968

SYSTEM
DEVELOPMENT
CORPORATION
2500 COLORADO AVE.
SANTA MONICA
CALIFORNIA
90406

An earlier manuscript of this document was submitted to the Southwest Regional Laboratory in March, 1968.

Instructional Management System Project* staff members include J. E. Coulson (Project Head), B. Kooi, J. Bratten, D. Marsh, D. McLane, T. Collins, C. Geddes; and J. Bailey and M. Yasuda (Southwest Regional Laboratory).

---

*The Instructional Management System Project is part of the Instructional Technology Element directed by H. F. Silberman.

ABSTRACT

This document describes progress in the development and demonstration of the computer-based Instructional Management System (IMS) during the period March 1, 1967, through February 29, 1968. The rationale and design considerations of IMS, development of its system components, functioning of the components during the first field trial, and data collected during the first field trial are discussed in this progress report.

IMS is designed to aid teachers in the individual monitoring and management of student progress. The teachers administer frequent tests, which are keyed to behaviorally defined objectives and printed on machine readable forms. Data input procedures transform pupil responses for computer analysis, and the computer generates a report to be delivered to the teacher the next day. The computer-generated report contains an analysis of pupils' achievement of objectives and suggests remedial exercises for those who do not meet the criterion performance level.

The initial field trial of IMS began in September, 1967, with four first-grade classes from two Los Angeles elementary schools participating. After a few trials and procedural adjustments, mechanical components of the system performed to specifications set for the first demonstration. However, analysis of available data revealed that teachers did not consistently use information provided by IMS to make instructional decisions. New materials and procedures were designed to improve the system for the spring 1968 school term.

TABLE OF CONTENTS

The basic premise underlying the design of IMS is that classroom instruction can be made more individualized and effective only if the school has accurate, timely information about (1) how rapidly the students are progressing, (2) what learning difficulties they are experiencing, and (3) what instructional materials or other resources are available to the school to remedy specific deficiencies in student performance.

Such information is clearly not available today in most schools. Except at the most gross, intuitive level, most teachers have minimal knowledge about the class as a whole, let alone the specific strengths and weaknesses of individual pupils. Tests are so infrequently administered that they offer little day-to-day guidance to the teacher. Moreover, these tests are seldom designed to diagnose specific learning deficiencies, but instead yield gross measures of overall performance. They are intended to provide normative ratings, not to tell the teacher whether a given pupil or group of pupils has successively mastered a specific skill such as visually discriminating words on the basis of their initial consonants. Yet this specific information is what a teacher requires to direct the instruction to the pupils' needs.

Seatwork exercises and homework assignments are often used by teachers to elicit more active pupil participation, but again, the results of these activities are seldom used to guide the teacher in any specific fashion. Unless the teacher has an exceptionally light teaching load, or is unusually favored in clerical assistance, he has little time to look over every pupil response. He has even less chance to analyze response patterns in any systematic way so as to identify specific learning deficiencies. By the time he could perform such an analysis, he would probably be well past that point in the instruction and on some entirely different topic.

Typically, the teacher has only incomplete information about the instructional resources available to him. He is often not aware, for example, of supplementary material in the school or in the district office. More importantly, he has no comprehensive catalog of materials keyed to specific learning objectives, so he cannot effectively match resources to needs.

IMS is designed to remedy the information deficiencies described above. It gives teachers both diagnostic and prescriptive information about students in the classrooms. A computer used in IMS stores pupil performance data and information about available seatwork materials. As the pupils complete each instructional unit, they are given criterion-referenced diagnostic tests on machine-readable answer sheets. Test results are used to update the pupil performance records, and on the day after each test the teacher receives machine-prepared summaries showing the pupils' progress and indicating which pupils performed poorly on which tasks. The summary also suggests alternative instructional materials that the teacher might use for pupils with specific weaknesses. Through a teletypewriter terminal, teachers can query the computer's data base for additional performance information.

B. IMS DESIGN CONSIDERATIONS

Three major guidelines are applied in the design of IMS. The first is that IMS should be a practical system for operational use in public schools; the second is that it should have the flexibility for evolutionary development; and the third is that it should incorporate a built-in self-correcting mechanism for successive improvement through empirical trials and revisions. These guidelines are discussed below.

Practicality. Practicality means that IMS must be user-oriented and that it must be cost-feasible. To insure a user-orientation, IMS was designed from its initial conception with the school teachers in mind. Teachers and school administrators participated in the original planning and system design, and teachers aided in the development of materials and procedures used in IMS. The formats of printouts and other displays produced by IMS have been modified several times to make them more easily understood and acted on by the teachers. New functions are currently being added to IMS at the suggestion of teachers who have gained familiarity with the system and envision further capabilities that can aid them.

Cost-feasibility is a major advantage stemming from the fact that IMS does not use the computer to interact directly with students. Few terminals are required by IMS, and the computer can operate largely in a batch-processing mode without waiting for inputs from humans operating at a much slower pace. For these reasons, IMS is much less expensive than CAI for an equal number of students. Once IMS has progressed from its present developmental stage to a routine operating system, it should be capable of being supported directly by school districts.

Evolutionary Approach. An educational innovation may be sound in concept and design, yet it may encounter strong resistance in the schools if it requires any abrupt changes in the routine organization and management of school operations. For this reason, it is often more effective to take an evolutionary approach in which the innovation is introduced through a succession of small steps so that school personnel become well adjusted to each step before moving to the next.

The plan for implementation of IMS is based on this evolutionary approach. The initial design of IMS permits it to be used in conventional public schools with virtually no change in a school's organization or structure. IMS presently operates most of the time in a group-paced mode, because this is the most common organizational mode in the schools where IMS has been introduced. Furthermore, it uses the schools' existing curricula, rather than attempting to force a new curriculum on the schools. Instruction is provided by the teachers just as it was previously. The one change is that the teachers in classrooms using IMS now have access to much more information about student achievement and about the resource materials available to help the pupils reach specific learning objectives. In short, IMS is designed initially to help teachers do their present job more effectively, not to make drastic changes in the nature of that job.

Nevertheless, the long-range objective of IMS is to facilitate change in the schools toward an individualized mode of instruction, and IMS is designed with sufficient flexibility to operate in almost any instructional mode, from a completely lockstep system to a continuous-progress system in which every student progressed independently. It is anticipated that, as teachers become familiar with the initial version of IMS, they will see more clearly the need and opportunity for a higher degree of individualization and will request more assistance from IMS in helping them to move in that direction. Thus, subsequent changes in the operation of IMS will come in direct response to the needs perceived by the school personnel.

Self-Correcting Mechanism. Experience in the development of educational systems has indicated (1) that no complex system will operate effectively when it is first tried out, and (2) that no systematic improvements will take place in the system unless there is a built-in improvement mechanism in the original system design. IMS incorporates such a mechanism, because an intrinsic part of its operation is the collection of data reflecting the performance of IMS and of the school system in which it functions. Classroom performance reports and other displays available through IMS provide convenient means for assessing the degree to which IMS is serving its function as an aid to teachers in the monitoring and management of classroom instruction. The application of this self-correcting mechanism has already led to a number of modifications in the IMS design.

II. GENERAL DESCRIPTION OF IMS

Figure 1 is a simplified diagram of the information flow in the initial IMS. The large box in the left of the figure represents one of the participating schools, and the right-hand box represents the data-processing facility at SDC. At the end of a school day, a courier collects test sheets from the teachers and brings them to SDC, where they are read by an optical scanner. The scanner produces punched cards representing, in digital form, the responses of the students. The cards are read onto a magnetic tape, which in turn is read by an IBM Q-32 computer located at SDC. In the Q-32, the raw response data are associated with an answer key to produce individual and group scores on different learning objectives. The objectives are also associated in computer memory with specific segments of seatwork exercise materials. Thus the printouts produced by the computer tell the teacher not only how students are performing, but also what material he can give to a student or to a group of students to remedy each learning deficiency. These printouts are carried back to the school, and in the morning each teacher finds the performance summary form for his pupils in his mailbox. If he wishes more detailed information about a particular student's performance on a particular objective, or if he wants background data such as the results of standardized aptitude tests, he can request such information through a teletypewriter that communicates over a telephone line with the SDC computer.

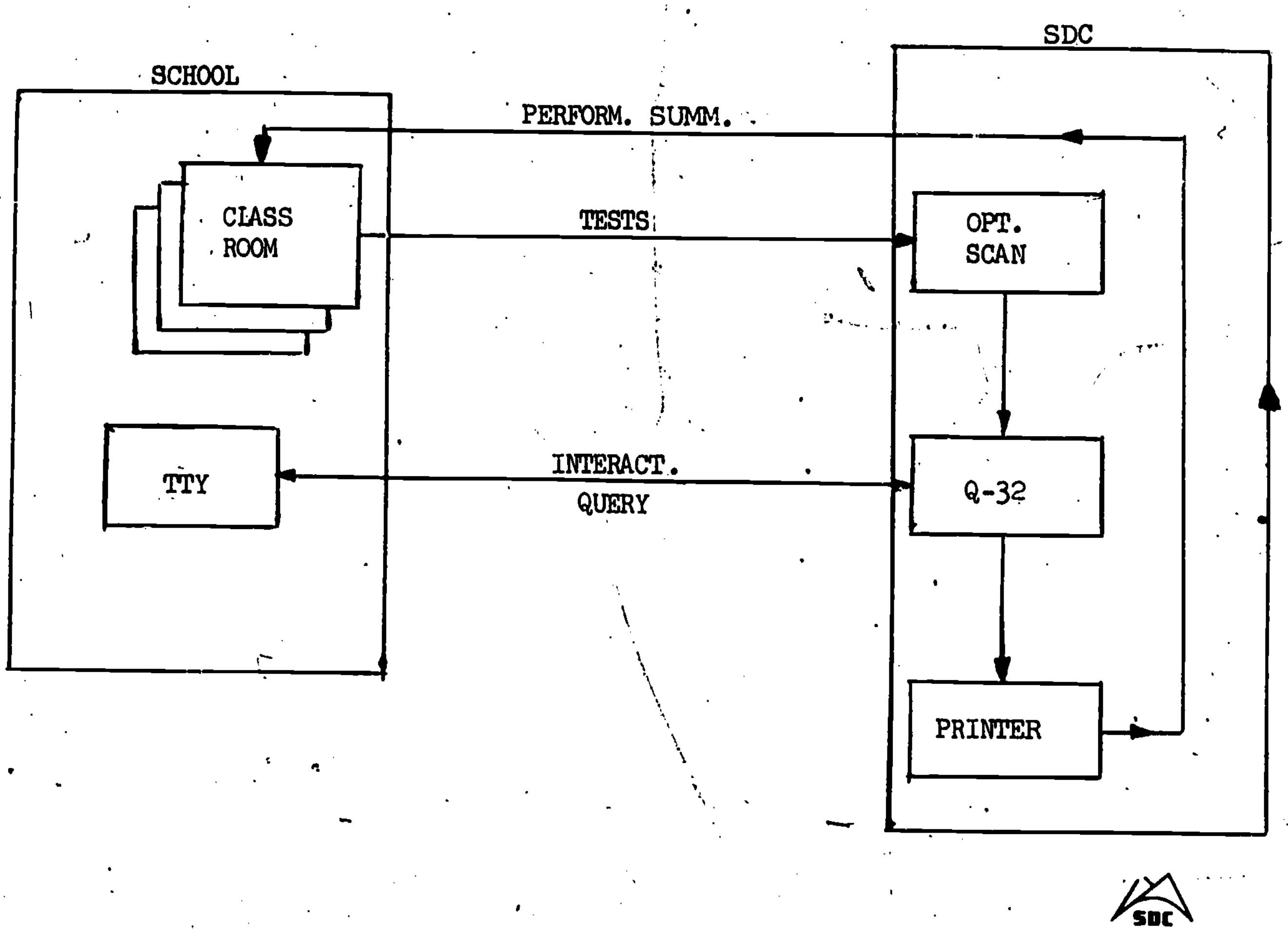

Figure 1. IMS Information Flow (Initial Design).

III. IMS DEVELOPMENT PLAN

This report is primarily concerned with the contract period of March 1967 through February 1968. However, to place the activities of this period in perspective, Figure 2, below, shows the longer range IMS development plan covering the period from June 1966 through February 1969.

From June 1966 through December 1966, the preliminary design of IMS was formulated. This task included the specification of equipment requirements, the design of computer programs, and the initiation of meetings with district administrators from the Los Angeles City Schools to establish criteria for the selection of IMS demonstration schools. A report of these activities is contained in the Instructional Technology Module Progress Report dated September 1, 1966, and in SDC document TM(L)-3298/001/00, "Progress Report: Instructional Technology Module," January 16, 1967.

In the period from January 1967 to September 1967, two IMS demonstration schools (Roosevelt Elementary School and Brentwood Elementary School) were selected, the initial package of diagnostic tests and other IMS materials was prepared, computer programs to provide IMS data processing were written and tested on the Q-32, student carrels and associated listening posts were constructed and installed in the schools, and four teachers from the demonstration schools were given extensive indoctrination and training in the use of IMS in their classrooms.

The demonstration (Q-32) version of IMS became operational in September 1967, at which time it was first used in two B1 classes (first semester of the first grade) in each of the two demonstration schools. Operation continued in the two schools throughout the fall 1967 semester, during which time several modifications were made in the design of materials and in some of the data-processing procedures. System performance data were collected, and plans were made for a number of additional modifications to be introduced in the spring 1968 semester in the demonstration classes.

More data will be collected on the operation of the Q-32 version of IMS during the spring 1968 term, and procedures and materials will be further modified wherever the system is found deficient. At the end of the term, all observations and procedures will be documented and users' procedural guides will be written. SWRL staff members will also be trained in the operation of the Q-32 IMS so that they will be able to assume responsibility for its continued operation after June 1968.

A parallel activity during the contract period from March 1968 through February 1969 will be to transfer IMS to a form operable on an IBM 360/65 computer. In this form, it should be possible to adapt the programs easily to the computer that SWRL will probably acquire in the first half of 1969. It is anticipated that SWRL will then use its computer to provide continuing IMS services to selected schools in the region.

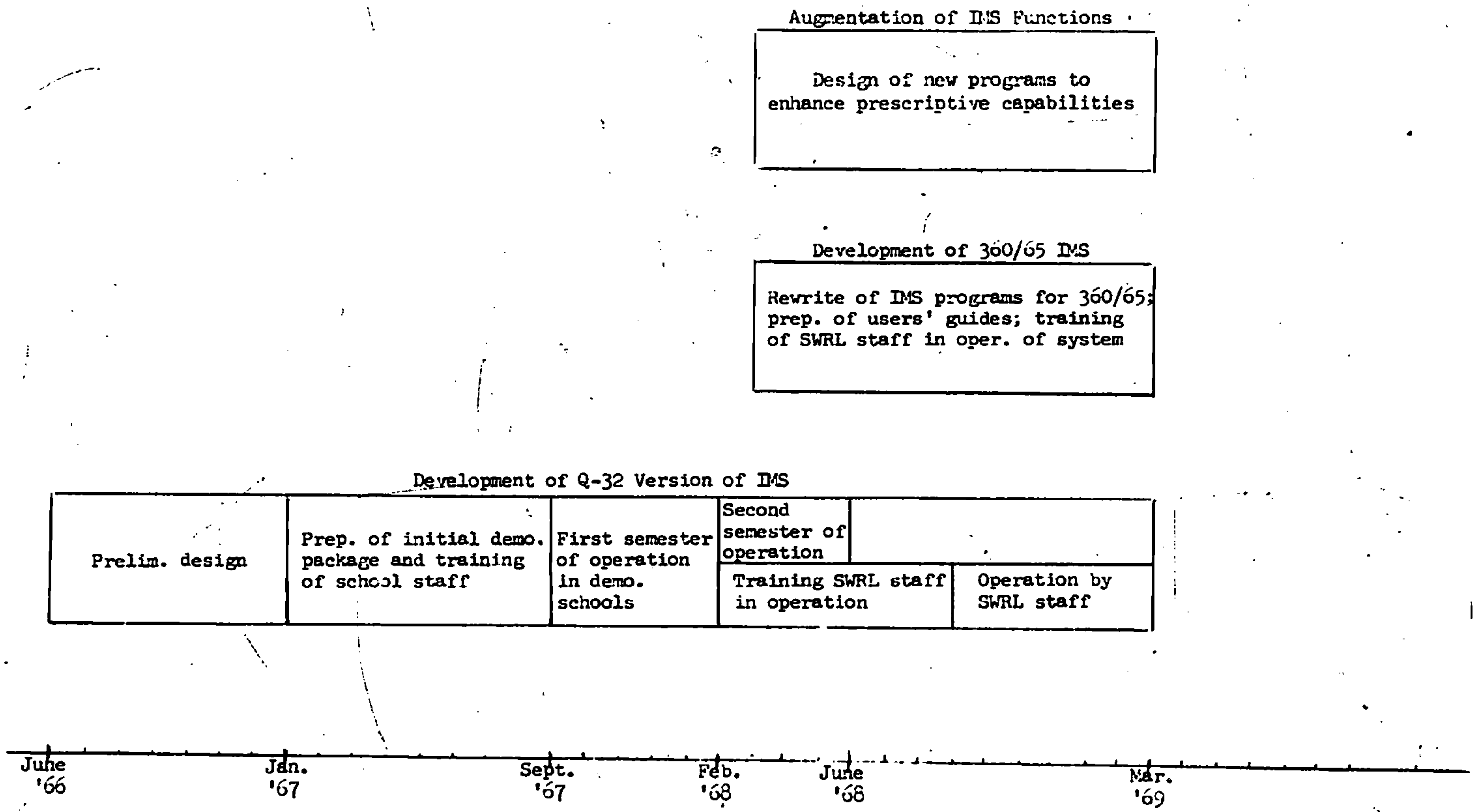

Figure 2. Plan for Development of IMS.

Also in the coming contract year, IMS project members will design and begin to develop major additions and modifications to the initial IMS, to enhance its capabilities. In particular, the prescriptive capabilities will be strengthened so that IMS can give teachers more active assistance in the design and preparation of exercise materials to remedy learning deficiencies detected by the system. Beyond the time span represented by Figure 2 (i.e., after March 1969), the new prescriptive capabilities will be further developed until they are ready to be incorporated as a regular part of the IMS operations.

IV. INITIAL IMS DESIGN

A. TESTS AND PRESCRIPTIVE MATERIALS

Levels of Testing. The Instructional Management System operates through a set of computer programs and classroom testing procedures. Since tests have several functions in classroom management, IMS was designed to allow several levels of testing. To illustrate, the teacher may only wish to have tests scored and scores accumulated for each pupil over the semester; for this she would use the assessment level of IMS. Or, she may wish to have pupil performance analyzed in relation to instructional objectives; in this case, she would employ the diagnostic level. If, in addition, she wanted to have the system suggest activities for the child who was not meeting particular objectives, she would use the prescriptive level of IMS.

Each level of the system provides greater management capability but requires more teacher input for operation. In any level, pupil responses must be acceptable to the computer for analysis. To meet this requirement, IMS pupils mark their answers on sheets that can be read by an IBM optical scanner. Responses on these sheets can be scored and added to a data base of information within the computer. The assessment level of IMS is made up of such scoring and accumulating of scores.

If the teacher wishes to use the diagnostic level, to find how a total test score breaks down into a pattern of skills, she provides a list of objectives and keys particular test items to those objectives. The objectives may be general, as "The child can use map-reading aids provided in a legend," or they may be specific, as "The child can indicate the distance between two points on a map that shows a scale of miles." In addition to reporting a pupil's overall score, the computer can then supply partial scores associated with objectives. From these a teacher might learn, for example, that a child's failure was associated entirely with not recognizing irregularly spelled words, while he could decode regular words quite adequately.

The third and most intensive use of the system, the prescriptive level, provides suggested lesson plans for the teacher as well as assessment and diagnostic information. For this use, lesson plans and materials associated with each objective are provided. Then the computer can select procedures for teaching, based on information gained about the performance of individuals and groups. This information is provided on a computer printout. SDC used the prescriptive level of the system, with all of its objectives, tests, item keying, and suggested remedial materials, for the initial IMS demonstration. Four first-grade classrooms participated and were provided the full semester's materials. Other teachers in the same schools were also encouraged to use the system, and several of these teachers did use it at the assessment or diagnostic level.

General Plan for Test Construction. Few teachers in conventional classes prepare a comprehensive set of tests covering an entire semester's work in advance of the semester. Typically, although a teacher may have a good overview of the total semester's course, she writes each individual test just before she administers it. This *ad hoc* approach to the preparation of tests was not practical for the initial IMS demonstration, partly because a completed set of materials and procedures was needed in advance to guide the programmers in defining the requisite computer programs. Consequently, a group effort was initiated, many months before the start of the fall 1967 school term, to write IMS tests and select remedial materials for the 1967-68 school year. The members of the group included a team of teachers from two Los Angeles schools, staff members of the Southwest Regional Laboratory, and personnel from System Development Corporation. Details of the test development effort, which was one of the largest and most important in the total IMS project, are described in Appendix A.

There was no attempt to develop a new or "ideal" instructional program. Instead, project personnel tried to reflect faithfully the teachers' existing instructional objectives and sequence in a program of frequent tests. There were two reasons for modeling materials on currently operating programs. First, there was inadequate time to construct a new program or to adapt one to the ongoing operations of the cooperating classrooms. Second, it was felt that teachers would recognize the utility of the management system more readily if it helped them achieve their own objectives than if it imposed a new set of objectives.

Overview of Test Structure. A set of 50 prototype tests was developed to initiate the operational system during the 1967-68 school year. This set includes 8 tests in reading readiness, 27 in reading, and 17 in arithmetic. The reading tests are correlated with the Ginn Basic Reading Series and the arithmetic tests follow the S.R.A.--Greater Cleveland materials, since these are the programs used in the Los Angeles schools where trials were conducted.

The structure of tests in all three areas is essentially similar. For this reason, only the structure for the most extensive set of tests, those in the area of reading, will be described.

A reading test was provided after every third story in the reader; on the average this corresponded roughly to one week of classroom instruction. Each test contained six or seven pages, constructed in a variety of formats. One format is illustrated in the phonic analysis sheet taken from test 16 (see Figure 3). The items in this sheet require the pupil to read the stimulus

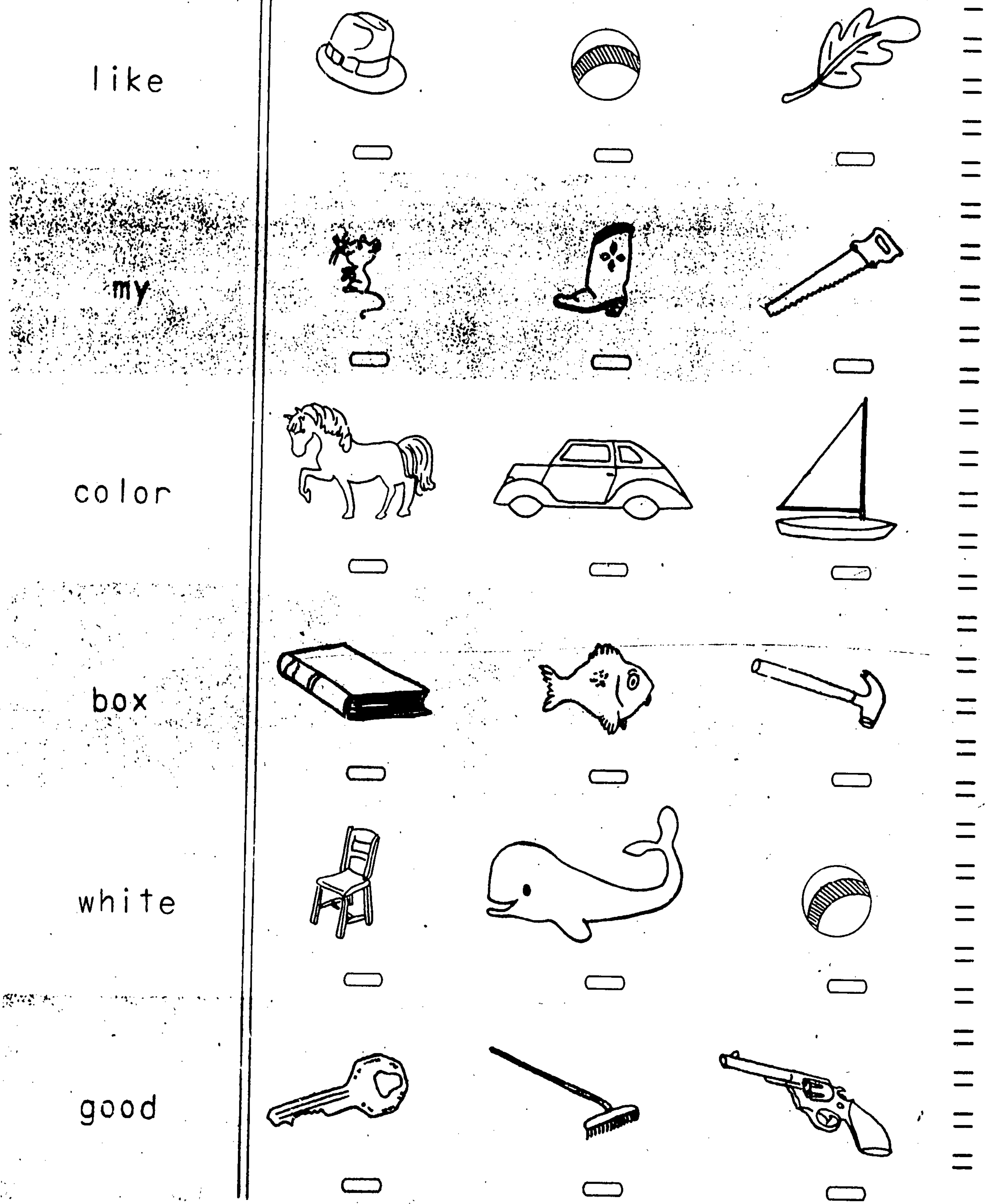

Figure 3. Test Sheet Example. (In the actual forms, shadings and answer spaces are printed in red.)

word on the left and then mark the appropriate response picture on the right. The name of the correct response picture begins with the same letter as the stimulus word. Other formats used in the reading tests require matching a word on the left with one on the right, reading a short paragraph at the top of a page and answering questions about it in frames below, reading a sentence and selecting another to which it is logically related, or listening to the stimulus word being pronounced by tape recording and selecting that word from three choices on the test sheet. The variety of different formats is illustrated by the blank format sheets in Appendix B.

General and Specific Objectives. The reading tests were designed to measure performance on ten general objectives. Each general objective was further broken down into 3 to 21 specific objectives (listed in Appendix C). From these specific objectives were derived the 909 test items that constituted the 27 reading tests. Each reading test contained from 27 to 44 items representing from four to seven general objectives. Figure 4 shows the item breakdown by test and general objective for the original tests.

The selection of specific objectives on any single sheet was governed by the vocabulary and story content in the immediately preceding lesson. For instance, in the illustrated sheet from test number 16, all stimulus words are taken from the three stories that pupils have most recently completed. Since each item requires the child to discriminate an initial consonant sound, all items are classified as part of a single general objective. However, each vocabulary word from the immediately preceding lesson begins with a different consonant, so that six different specific objectives, represented by those consonants, appear on the test. The complete breakdown of items by specific objective for the original reading tests is shown in Appendix D.

Criteria for Prescriptions. Where possible, the decision to prescribe additional instruction was based on responses in a single test, so that any prescription given would entail follow-up work directly relating to the specific objective failed. In some cases, however, a specific objective was represented by very few items on a test. For the general objective of word recognition, for instance, in only 7 of the 89 cases in which a specific objective was represented on a test were there five or more items to use as a basis for establishing criterion performance. The alternative to using a single test to establish criterion behavior was to accumulate items from test to test until sufficient numbers were accrued. The IMS computer programs allowed this possibility, and it was used many times in the testing program.

An 80/80 criterion level was selected for each test; that is, unless a score of 80 percent was attained by 80 percent of the group taking the test, remedial follow-up work was prescribed. In practice it sometimes occurred that the items representing a general objective on any test were thinly distributed among its specific objectives, but were still highly interrelated as to subject matter. This problem occurred in phonic analysis, for example, where the item content was determined by the possible initial consonant sounds available in the words

Test Number	Visual Discrimination	Word Recognition	Vocabulary Confusions	Phonic Analysis Initial Consonants	Phonic Analysis Final Consonants	Phonic Analysis Medial Vowels	Structural Analysis of Words	Word Comprehension	Sentence Comprehension	Paragraph Comprehension	TOTAL
1	5	5	7	10	3			8			38
2	10	5	4	11				8			38
3	17	6	2	6				6			37
4	18	5	2	6			6		3		40
5	17	7	1		6				3		34
6	21	7		6				7	3		44
7	7	7		6				12	4		36
8		7		6	6				4	7	30
9	6	6	2		6			6	4	6	36
10		7		6					4	10	27
11		7		6	6			6		10	35
12	7	7		6					4	10	34
13		7			6		2	4		10	29
14		6	1		6			12	4	7	36
15		7			6				4	10	27
16		12	2	6						10	30
17		14			6			6		6	32
18		14		6					4	6	30
19		14		6	6					10	36
20		14		6				10	4	3	37
21		14		6				6	4	7	37
22		14			6			6	4	5	35
23		8		6				10		6	30
24		7				6		6		10	29
25		7		6				6	4	6	29
26		7				6		6	4	10	[illegible]
27		7		6				10	4	3	30
TOTAL	108	228	21	117	63	12	8	135	65	152	909

Figure 4. Reading Test Summary: Items Broken Down by Test Number and General Objective

of the current lesson, and where items were thus widely distributed over specific objectives. In such instances, the general objective was treated as a test, and a resulting prescription covered all of the specific objectives tested.

Prescriptions. Prescriptions were usually a single sheet of seatwork typical of that currently used in classrooms throughout the city. These sheets contained practice items similar to those missed on the test, with tape-recorded instructions provided when necessary. Several sheets could be used in one day if pupils' scores were low on more than one objective.

Prescriptive seatwork for IMS was taken from several sources. Since teachers in the Los Angeles School System were already provided a set of seatwork materials keyed to the Ginn Basic Readers, that set was examined first. A page of exercises was included in that source for every story in the reading series, utilizing the vocabulary introduced there. However, the skill most often required on those sheets was visual discrimination--simple matching of words. Development of phonic analysis or comprehension was scarcely represented. Developmental trials of IMS tests showed that pupils almost always scored 90 percent or better in visual discrimination, so the school system materials were of little use.

Many other commercial materials were examined, but they presented two problems. One was, again, poor representation of skills; the other was use of a vocabulary that the pupils had not met in their readers. With publishers' permission, a few appropriate sheets were taken from several of these commercial sources and keyed to IMS objectives.

The IMS staff then turned to the system's first-grade teachers for help in constructing other sheets of items that were needed. Two of the teachers worked at SDC during the summer before IMS operation, selecting and constructing remedial follow-up materials that would provide practice on IMS objectives. Simple directions were typed on each sheet of work for easy teacher reference. In this way, about 200 sheets were provided for the first-grade classes in the fall, one for each objective represented on each sheet.

Filing System. A coding system was devised for the follow-up materials. Each sheet was labeled with the test number followed by the objective number of the work represented. For instance, R2-0403 on a sheet meant that it was for reading test two, specific objective 0403 (phonic analysis--auditory discrimination of words with the initial letter "f").

Thirty sheets of each piece of work were placed in folders with the same code number for each classroom. The folders were arranged in test and objective sequence in filing cabinets in each participating classroom. Thus, when teachers received printouts that called for remedial sheets by code number, they had only to remove enough sheets from the filing cabinet and use them with the group during their follow-up period.

B. DATA PROCESSING

Version I of the IMS information processing system has been operating since the first week in September 1967. This version was used during the entire first semester with only minor changes. These changes and those made for the second semester are described in Section VI.

Figure 5 shows the major components in the initial data-processing system. The central component is the LUCID general purpose data management system, which operates under the time-sharing executive on the Q-32 computer. The LUCID system is used to store and retrieve the information that is necessary to produce reports of student progress. Four other IMS program components, SSU, PROG, QUERY, and IMSOL, also operate under the Q-32 TSS executive. These programs serve as control programs for parts of LUCID; SSU formats data so that it is acceptable by LUCID, PROG produces regular student progress reports from data retrieved by LUCID, and QUERY enables a user to directly address the LUCID data base to obtain information. IMSOL, an on-line program that composes reports, was added late in the semester. It is described in Section VI below. The fifth IMS component, labeled DIP in Figure 5, is a set of manual and mechanical procedures to convert data from original source documents (tests, rosters, etc.) to a binary tape acceptable to SSU. The next paragraphs give a more detailed description of the four initial components of IMS in the order in which they are used for processing student performance data.

Data Input Procedures. These procedures are divided into two sets. One set, which is necessary to prepare IMS so that it can be used by teachers, functions only at the beginning of the semester. The other is required for the ongoing day-to-day use of the system. The first step in initial preparation of the system for operation is to describe the structure of the course in terms of objectives, tests, and prescriptions. This description is placed on punched cards and is read into the LUCID data management system. The second step in preparation is to store descriptive information, such as names of students, teachers, and schools, in the data base. These names are thus made available to the data management system for association with student response data.

Collection of the descriptive information to prepare IMS for operation is accomplished through forms especially prepared for this purpose. These forms are filled out by teachers and by personnel who prepare the test materials. They include a course description outline that lists general and specific objectives by label; a test input form that associates individual items, teacher determined criterion levels, and prescription code numbers to objectives being measured; and a variety of school, teacher, and pupil rosters (see Appendix F). The completed forms are manually transferred to punched cards and prestored on tape for entry into the Q-32.

The procedures used for putting information into IMS on a day-to-day basis start with the test forms. One answer form for each test is filled out with the correct

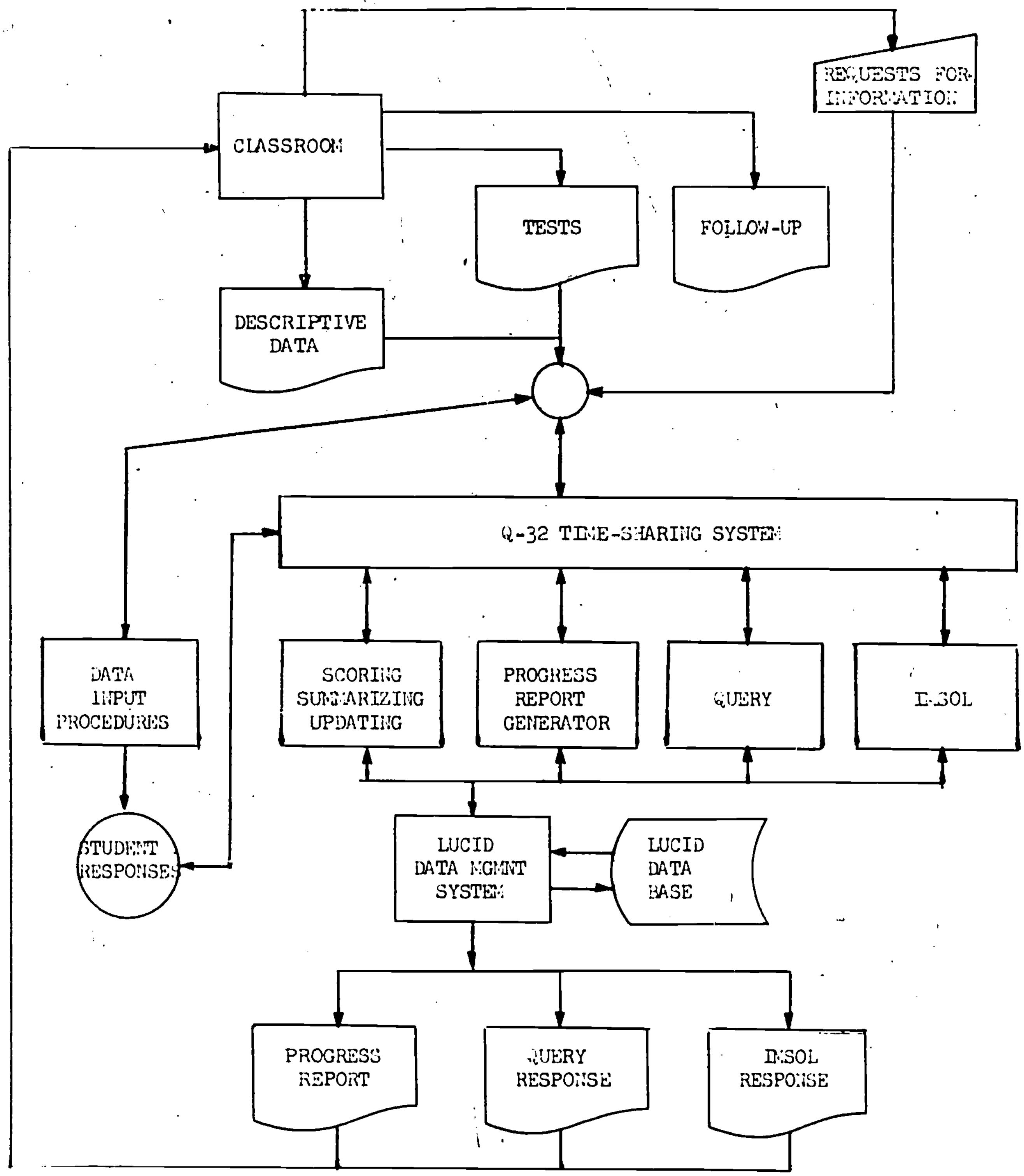

Figure 5. IMS First Semester Version.

answers marked. These forms, designated as belonging to student number 00, are stored in the LUCID system and used as test keys for scoring student-produced tests. As groups of students take tests in the classrooms, the answer forms are brought to SDC by courier for processing with an IBM 1232 Optical Scanner. Because of the novelty of this scanner use, it is described in detail in Section C below and in Appendix B. The data from the scanner are placed on electronic tape, and the tape, containing the day's yield of student test data, is then mounted on the Q-32.

Scoring, Summarizing, and Updating. The program to accomplish these functions is written in the JOVIAL language and operates on the Q-32 TSS. The program SSU reads the student response tape, interacts with the LUCID data management system to obtain test keys (the responses for student 00), and scores each test item. SSU next computes the percentage of correct items for each major objective included in the test and sends this information to LUCID. The number of correct responses for each specific objective is also counted and the result is sent to LUCID. When these tasks are accomplished for each test, the update function of LUCID is operated and the LUCID data base is changed to reflect the new performance data. At this point, SSU is finished with its tasks.

Generation of Progress Report. PROG is another program written in the JOVIAL language for the Q-32. Once SSU has been operated to insert the performance data in LUCID for a group of students, PROG is used to retrieve and format the data necessary to produce a progress report. PROG encapsulates the query and update function of LUCID, using this program to accomplish the required retrieval tasks. This system design feature makes it a relatively simple programming task to change the format of the report so that it is optimally useful for teachers.

The progress report is produced by the IMS upon receipt of a batch of tests from a teacher. It is delivered to the classroom before the next class meeting so that the teacher can use the information to pace her groups, regroup her students, and provide follow-up work based on deficiencies uncovered by the tests. Figure 6 is an example of the progress report used during the fall 196[illegible] semester.

The report is oriented to a specific group taking a specific test. On a particular day, a teacher receives a report for each group test administered on the previous day. The report (see Figure 6) contains a heading that gives the date of the test, the school building, and the teacher's name. Following this, the course (subject), group name, test number, and textual material covered by the test is included. The next three lines on the report constitute a summary abstracted from the detailed information and prepared by PROG. This summary is intended to give the teacher a quick overview of the results of the test. Part A of the report proper pertains to the "Bluebirds" group. In the first column are listed the 1[illegible] general objectives for B1 Reading and under the heading "SCORE THIS TEST" is the average percentage score made by the group on

BUILDING WASHINGTON DATE 11/06/67
TEACHER HELEN ROBERTS

B1 READING BLUEBIRDS
TEST 9905 GREEN BOOK, PP. 3-14

THIS GROUP DID WELL ON VISUAL DISCRIMINATION, SPECIFIC WORD CONFUSION, PHONICS, FINAL SOUNDS. THEY NEED MORE PRACTICE ON WORD RECOGNITION, SENTENCE COMPREHENSIONS. (ACTIVITIES R5-0203, R5-0904.)

A. GROUP REPORT

OBJECTIVE	SCORE THIS TEST	ACTIVITIES RECOMMENDED	CUMU-LATIVE SCORE
VISUAL DISCRIMINATION	88		93
WORD RECOGNITION	91	R5-0203	94
SPECIFIC WORD CONFUSION	100		96
PHONICS, INITIAL SOUNDS			95
PHONICS, FINAL SOUNDS	97		97
PHONICS, MEDIAL VOWELS			
STRUCTURAL ANALYSIS			91
WORD COMPREHENSION			98
SENTENCE COMPREHENSION	83	R5-0904	89
PARAGRAPH COMPREHENSION			
GROUP AVERAGES	89		95

B. INDIVIDUAL REPORT

NAME	SCORE THIS TEST	NUMBER OF TESTS TAKEN	CUMU-LATIVE SCORE
JENNY JONES	100	5	100
GREG MARSDEN	100	5	98
MARTHA COLE	100	5	94
BETTY PARSONS	97	5	94
DIANNE HOOKER	94	5	97
VIRGINIA DOUGLAS	91	3	92
SUSAN DRAKE	88	4	95
GERALD EFFINGHAM	44	4	78
BRENDA ASH		1	100
KAREN ROGERS		4	98

Figure 6. Example of Progress Report Produced by IMS.

those objectives included in the test. Note that some objectives are not covered by this particular test. The second column, "ACTIVITIES RECOMMENDED," gives the location of prescriptive follow-up activities that the teacher can use to exercise specific objectives on which the group failed in this test. Prescription is based on performance on specific--as contrasted to general--objectives. This is illustrated in Figure 6, in that even though the Bluebirds performed generally well in "WORD RECOGNITION" (91 percent correct), they failed to attain criterion on one of the several specific objectives included under this category. The system sensed this failure and recommended a follow-up activity to exercise the specific objective. The final column, "CUMULATIVE SCORE," shows the percentage of correct responses made by all Bluebirds for each general objective over all tests taken by the group. Note again that one objective--"PHONICS, MEDIAL VOWELS"--has not yet been tested.

Part B of the report gives information on the individuals in the group. This section shows each pupil's name, his percentage of correct responses on this test, the number of tests in the subject that he has taken, and his cumulative score over those tests. This section can be used to assess the appropriateness of group membership. For example, "GERALD EFFINGHAM" is performing distinctly differently from the others and may be a candidate for reassignment to a "slower" group.

Interactive Requests for Detailed Information. The QUERY program is provided by the query and update function of the LUCID system. This function is named QUUP and can be requested from a console to interrogate a LUCID data base interactively. On the assumptions that teachers (1) required detailed and specific performance data on individual students, (2) could learn to use a simple command language to obtain information through a teletypewriter station hooked to a computer, and (3) would take their free time to make inquiries, a teletypewriter was installed at each of the two schools where IMS is operating. This station enables a user to dial the SDC Q-32 over a regular telephone line that provides an automatic link to the time-sharing system (see Figure 5). The user can request IMS QUERY, call for the IMS data base, and enter requests for information. The QUERY program receives the requests, finds the information, and prints it out on the teletypewriter at the school. Using this program, a user can obtain an almost infinite variety of listings. Classroom rosters, group rosters, individual performance records by specific objectives, group performance, and lists of prescriptions are a few examples.

C. AUTOMATED COMPUTER INPUTS: THE IBM SCANNER

The greatest portion of the IMS data base consists of results for each student on the IMS tests. Information is continually being added to this file or revised as new tests and retests are given throughout the semester. Teachers need the feedback on student performance almost immediately; therefore, a method for rapid and reliable transfer of test response data into a machine readable form was required, so that the computer could evaluate the students' responses and identify any necessary prescriptions. The Instructional Management System uses the IBM 1232 Optical Mark Page Reader in a somewhat novel way to facilitate this transfer operation.

Some optical-scanners are designed to interpret hand-written characters, others to interpret characters typed or printed in a special font, while others simply interpret horizontal or vertical pencil marks (bar codes) marked on an input document. The bar code type of scanner was selected for IMS use because this type has a relatively low cost, is very reliable, and requires the least skill in marking the response forms. The IBM 1232 scanner has these characteristics, plus simple operation and fairly rapid delivery time. Input documents for the 1232 are in standard $8\frac{1}{2}$ by 11 inch size and can be marked with a common #2 pencil. By operating off-line (i.e., not directly linked to a computer or data processing system), the 1232 remains independent of computer schedules and large system breakdowns. The 1232 can read up to 1,000 mark positions on each input document (see Figure 7). The positions are arranged in rows of 20, with spaces between each set of five. Each row of 20 is logically divided by the machine into two scanner words of 10 positions, and each scanner word is divided into two scanner segments of 5 positions each.

The principles of operation of the 1232 are relatively simple. Documents are fed into the 1232 face up, one at a time. The document passes under a read head (see Figure 8), where light from 20 light sources is bounced off the sheet and back into 20 photo-electric cells. When a mark is made in a mark position, the pencil lead absorbs a certain amount of the light, and the output of the corresponding photo-electric cell is reduced. It is the reduction of electrical output of the cell that is sensed as a mark.

The 1232 can read up to 2,000 documents per hour, but because it is attached to an IBM 534 keypunch, it is limited by the keypunch to 800 fully punched cards per hour. As with most bar code scanners, the input documents must be very precisely printed. Most of the tolerances are plus and minus five-thousandths of an inch. The scanner can sense most inks. Printed instructions, mark position boundaries, and stimulus materials must be printed with highly reflective inks in order not to be read by the scanner.

To meet IMS needs, the scanner input documents had to be modified to meet certain format requirements of the IMS tests. Prior trials had shown that some formats were more effective in presenting certain kinds of test items than were others. It was essential that the format or location of mark positions on the document should be variable throughout the test. The standard IBM mark positions appeared to be too small and tightly packed for first graders. IMS mark positions needed to be spread apart, enlarged, and decreased in number to make a simpler response document.

A solution was reached by arranging several different response formats on a basic 30-row IBM scanner sheet. Each format had fewer, larger mark positions centered on the positions of the basic IBM sheet. The identification of each

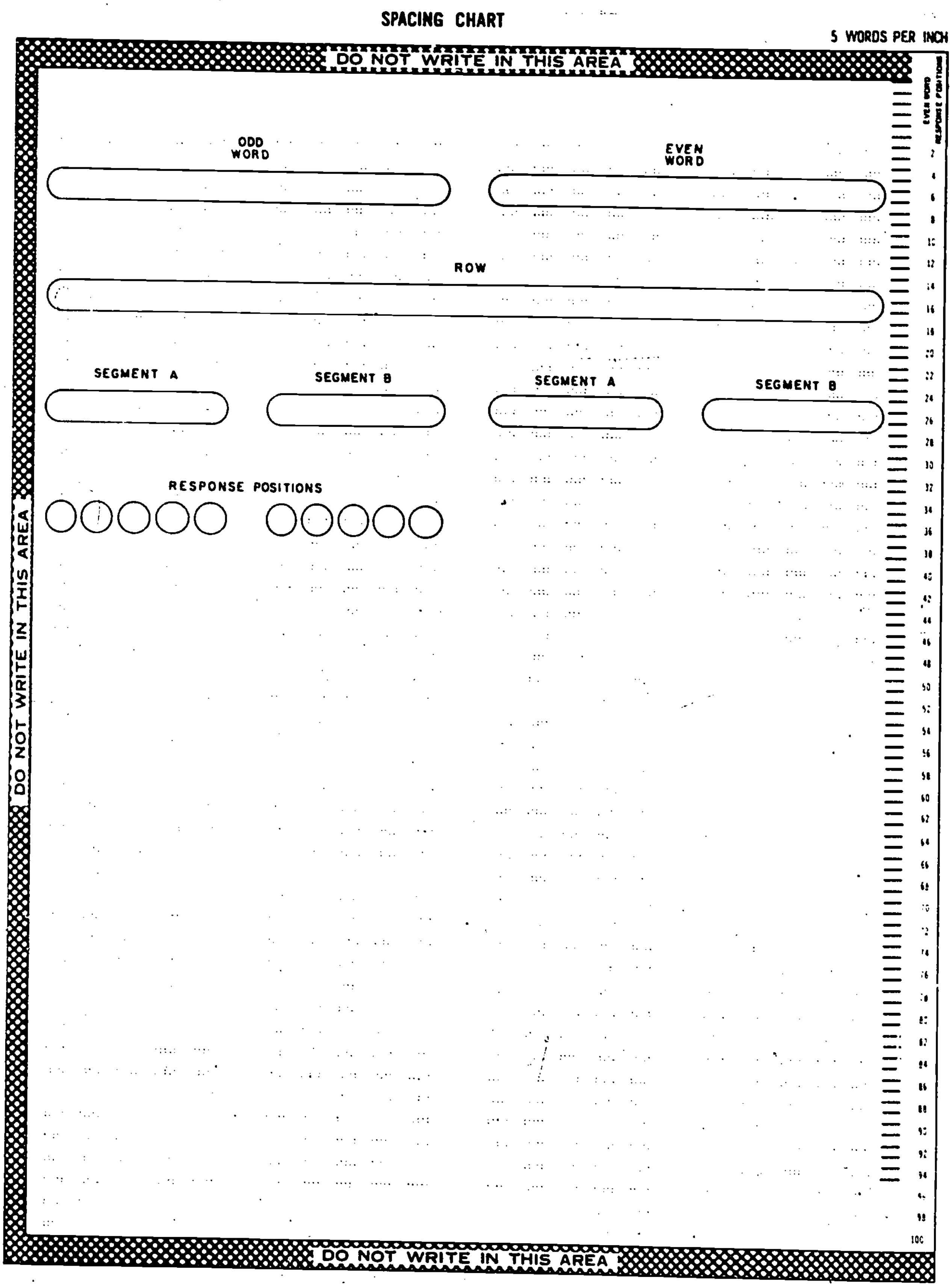

Figure 7. Mark Positions on Standard Scanner Form.

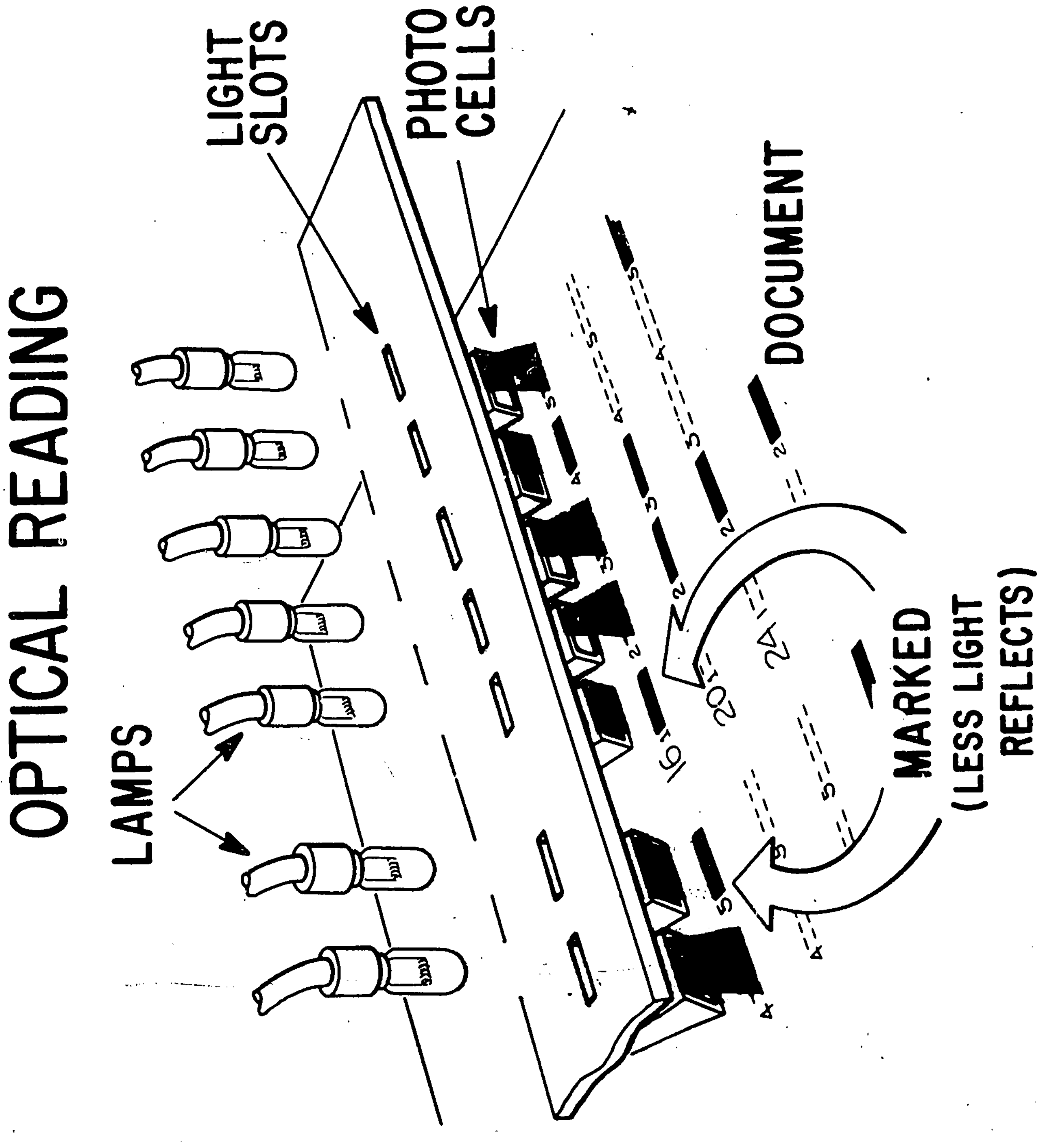

Figure 8. Operation of Optical Scanner.

"legal" IMS mark position on a given sheet was indicated by a preprinted, machine readable, format code placed in the last row of the input document. Although the scanner was programmed to read all 30 rows, 60 words, 600 mark positions on the $8\frac{1}{2}$ by 11 sheet, only 9 to 35 of the mark positions of any given sheet were printed on the sheet itself or interpreted by the computer processing program. Each of these mark positions described an oval area around the standard IBM mark position and approximately four times larger. The larger mark positions were broadly spaced across the sheet, so if a mark extended beyond the "legal" mark boundaries, there was little chance that a punch would be generated in the next position examined by the processing program. The scanner output deck was read by the computer in a binary mode, so that a multi-punch generated by a long mark could be examined for the presence or absence of the punch in the "legal" IMS mark position. Designation of "legal" mark positions allowed great freedom in sheet design. Items could be arranged horizontally or vertically, and/or across several scanner words.

To organize the materials so that first graders would be sure which stimuli went with an item, a pink stripe was printed over every other item presentation area. The resulting pink and white stripes on the test page served as a handy reference and check in the sequence of instructions to items in the test. Instructions like, "Now do the next pink row...," assisted the student in keeping his place in the test.

The scanner was programmed to punch out one card for every page of the IMS tests. To associate each of the pages of a test with a given student, a master mark sheet was used as a cover sheet. Students wrote their names on the cover of the test booklet, and a unique student number was coded into the four scanner words on the master mark sheet. The cover sheet did not generate a separate punched card as did the other pages of the test, but stored the coded student number in the scanner memory and punched it into four identification columns on the cards generated for each subsequent page. Each new cover sheet encountered in processing replaced the previous student number in the scanner memory and punched its code into the subsequent cards.

Maintenance of the test page order was essential to the processing. Items on the test were not identified to the scanner except by the order in which they were read, so if page five was accidentally processed before page four, the items on both pages would be mis-scored. To insure that the sequence of the items would remain fixed, the pages of the IMS tests were stapled together at the upper left-hand corner; the staple could be rapidly removed for processing, yet the pages could easily be turned when the students were taking the test. In addition, the pages were clearly numbered in large numerals in the lower right-hand corner.

Details of procedures used and problems encountered in production of the machine readable tests for first graders are given in Appendix B.

D. CLASSROOM PRESENTATION SYSTEM

The teacher's classroom schedule in the demonstration schools, though flexible, is built around 20-minute periods for work with each reading group. The IMS test exercises are designed to be administered during a 20-minute follow-up period while the teacher works in the circle with another reading group. Each child in the follow-up group works on the same test with directions presented by tape recorder through headsets. In the original design of presentation equipment, the directions were read for a single item or a page of similar items. Then the tape recorder stopped until each child pushed a button to signal that he was ready to go on. Thus, the tests were paced by the slowest child.

An individual presentation system that could provide this capability was the audio-frame system, produced by Appleton-Century-Croft, using a Norelco cartridge-type tape recorder. This system stopped automatically after three seconds of silence and was restarted by pushing a button. The system was expanded into a group system by adding a set of relays corresponding to a group of students--the last student to respond completed the circuit and restarted the tape.

The relay control box contained a set of switches, corresponding to the student positions, that allowed unoccupied positions to be selected out of the control circuit. Another switch allowed the teacher to play a separate sound source through the system--unaffected by the relays, the tape recorder, or the power supply.

The students listened to the instructions through headsets plugged into boxes in the students' carrels. Each box also contained a mini bulb (28 volts) and a clear plastic response button. When the child pushed his "ready button," the light went out; when the machine restarted (following the last student's response), the light came on again and remained lit until the student again pushed his ready button.

Recording System. Because the playback system was designed to stop after three seconds of recorded silence, there was a danger that it might stop unintentionally at times when there was a pause in the voice recording but when no written pupil response was desired. An example would be after the instruction "Turn to page two." To avoid this problem, the first tapes were recorded directly on a tape-cartridge recorder that had been modified by the addition of a switched 60-cycle tone generator. This tone kept the recorder running. When a stop was desired, the tone generator was switched off. After the master tapes were completed, four copies of each were dubbed.

This initial mode of operation proved unsatisfactory: (1) The 60-cycle tone intruded on the voice and seriously degraded the voice quality of the master tape; (2) the cartridge recorder was of sufficiently poor quality that the dubs made from it (the distortion of the master is roughly squared in the dub) were of very poor quality; (3) as a result of mechanical, human, or distortional errors, spurious stops occasionally appeared on the dubs; and (4) the switch controlling the 60-cycle tone generator announced itself with an annoying series of pops and clicks.

Most of these problems were overcome by recording master tapes on a high fidelity reel-to-reel machine and by development of a voice-actuated, switched-tone generator by SDC engineering. With this latter device, the tone was injected automatically when the voice stopped, but a silent input switch could be operated manually to turn it off when a stop was required. The resulting dubs were of much higher sound quality than under the former method of recording and were devoid of its annoying pops.

Study Carrel Design. The initial design for carrels provided for masonite panels attached to aluminum channel, providing spaces approximately 18" wide by 18" deep. The ready boxes were mounted on the center partition of the carrels, leaving room on the desk to place the test booklets. The carrels were to be placed on tables provided by the Los Angeles City Schools, and two sizes had been planned: student tables, $19\frac{1}{2}$" x $40\frac{1}{2}$", and library tables, 3' x 6'. The latter were unavailable, and 28" x 70" tables were substituted; this unfortunately reduced the size of the study spaces.

Because there were only two classroom groups for mathematics (compared to three for reading), as many as 16 pupil positions might be required for presentation of mathematics tests. This was arranged by adding an extra pair of jacks to a ready box at one end of each room's set of tables. An "extension" was connected to these jacks, allowing the use of at least four more headsets for students who could listen at adjacent tables, but who had no "ready buttons."

V. EVALUATION OF FIRST SEMESTER TRIAL

There were two major considerations in evaluating the fall semester's IMS demonstration. Since the primary objective of this year's project was to establish an operating system, the first consideration was that of practicality--the simple mechanical question of how IMS functioned. Did the teachers administer the tests? Did classroom tape recording systems operate adequately? Was the scanner versatile enough to handle the first graders' marks? Did computer programs function adequately so that printouts were generated accurately and on time? Did the interactive query capability operate? The available data, which are discussed in more detail below, indicate that these questions can be answered in the affirmative.

Though the purpose of this year's developmental effort was to build an operating system, mechanical functioning clearly was only the first problem. The system's built-in capability for collecting data that reflected IMS's own performance helped identify other problems. One of these, the need for procedures to strengthen teachers' use of data to make instructional decisions, became apparent quite early. This problem led project personnel to look more closely at a second aspect of evaluation: How successfully does the teacher in a typical classroom situation use IMS to facilitate pupil achievement of course objectives? Data collected to answer this question, both negative and positive, should guide development of more refined procedures to improve classroom remediation of instructional difficulties. These data are also discussed below.

A. MECHANICAL OPERATION OF THE SYSTEM

Several sources were consulted to obtain data concerning the operation of IMS. One source consisted of descriptive notes kept by project personnel as they observed IMS in operation. Records were kept by five project staff members: one who served as teletype operator and interacted with teachers, a second who had responsibility for classroom recorders and headsets used in presentation, a third who conducted scanner operations, and two programmers who operated the computers to produce output data. A second source of information consisted of classroom observations made by the school liaison person. She observed each classroom once a week during the reading period, following different groups from week to week as they progressed through the entire reading time cycle--one-third with the teacher in the reading circle, one-third doing follow-up seatwork, and one-third doing independent work. A third source of information was the regular classroom performance printout. The final source consisted of teacher observations and attitudes obtained through a questionnaire.

Test Administration. The first operational question concerns administration of the tests. The reading tests were designed to be administered after every third story in the reading books. In general, the teachers kept close to this schedule. When they were absent from the classroom due to illness, they fell behind with the exercises; however, they attempted to catch up quckly when they returned (while still giving the recommended prescriptions). There was considerable variation in the number of tests completed. The most advanced of three reading groups in one class completed all 27 of the reading tests, while the top group in another completed 24 tests. At the other extreme, two slow groups completed only the eight readiness tests and four reading tests. The eight remaining groups in the four classes progressed to points varying from test 7 through test 16. Positions of the groups in math ranged from test 2 to test 13 of the 16 math tests.

Thus, the tests were generally administered carefully and in sequence by the teachers. There were no major administration problems, but some confusion existed at times. One problem in test scheduling was keeping track of the various groups' progress through the tests. The difficulty resulted from differences in the different groups' rate of progress and from the fact that a teacher sometimes received two duplicate printouts, one a day or two later than the other. Duplicate printouts occurred when a child took a makeup test, or took a test with the wrong group, causing the computer programs to generate a second report with the added data.

Group mixups were a frequent occurrence in the beginning of the semester when the children were just learning the concept of grouping. Partly as a result of the multiple reports and the confusion in grouping, one teacher skipped six group tests and duplicated another three. Two other teachers skipped a total of four group tests and duplicated one. This, however, is a small number in relation to the total number of tests administered.

Another relatively minor problem in test administration concerned timing of tests. From earlier tryouts of the tests, their timing was tailored to fit into a 20-minute period. However, during the first eight weeks of presentation, a stop-tape system was used that presented instructions, then allowed each child to signal with a button push when he was ready to go on. Thus, directions for new responses were not presented until the slowest child was ready. This system made timing of the tests vary more than had been anticipated. To illustrate, a specific test, R1, as recorded by the observer, varied in length from 23 to 30 minutes. Others varied from 14 to 21 minutes and 18 to 26 minutes. The teachers' classroom schedule, though flexible, is built around 20-minute periods for work with each reading group. Since the tests varied in length, the teachers could not effectively plan lesson time. Occasionally an exercise was interrupted to take the children out to recess.

Classroom Presentation System. A second part of the operations to be considered in evaluation is the classroom presentation system. Observation of classes before the introduction of a management system led project members to believe that first-grade children could not work independently without having directions for single items or groups of similar items read to them immediately before they were expected to respond. The tape recording system was designed to make the tests self-administering by providing the needed directions. Teachers occupied with small group instruction would not then be interrupted by confused or idle children in other parts of the room. Since this was the goal, an effort was made to determine just how much independence the recording system afforded to children in the follow-up group. The classroom observer carefully recorded the number of times children from any group interrupted the teacher working in the reading circle.

The original stop-tape system caused a number of problems. Some children forgot to push their buttons, and some discovered they had the power to control the system by not pushing their buttons. This led to misbehavior at the carrels and interruptions of the teacher at the reading circle. In the rush of classroom activities, the teachers occasionally selected the wrong tape for the desired test and the children became excited when the paper and the taped instructions did not agree.

In addition to child-caused malfunctions, mechanical difficulties occurred: Sometimes a temperamental relay would not respond; some tapes had double stops on them. Sometimes imagined maintenance problems caused interruptions or delayed use of the system. Several calls were made to one particular room in which no problem whatsoever could be found with the electromechanical system. There were few post-installation maintenance calls that required actual maintenance work. These consisted of two calls to tighten bulbs that had come loose and four calls to repair broken headphone wires.

These problems were much more apparent at the beginning of the semester; the mean number of observed interruptions at that time ranged from 2.8 to 4.1 per 20-minute reading period in the various classrooms. Later in the semester, with the introduction of more simply designed equipment, this figure dropped to 0.8 and 1.0 interruptions in the classes observed. The same groups of children, when engaged in other independent activities such as painting or working puzzles, interrupted the teacher more often than they did when working in the IMS listening center.

The teacher also spent less time giving initial directions for IMS test sessions than she did for other activities. The liaison person observed 38 IMS test administrations and 32 equal time periods when the pupils were engaged in other activities. On 10 of the 38 test administrations and on 23 of the 32 comparison occasions, the teacher spent two minutes or more providing directions. Thus the presentation system facilitated classroom management by providing self-administered work for pupil follow-up.

Optical Scanner. A third consideration in evaluation of system operations is that of the optical scanner as an input device for the programs. Were first graders capable of learning how to respond on printed forms in compliance with recorded instructions? Could the optical scanner process documents that were bent, folded, and mangled in testing, marked with oversized primary pencils and corner-cut in preprocessing? Early testing and one semester's practice indicate that the answer to these questions is yes. From the earliest reading tests, the first-grade students from both schools demonstrated that they were capable of making good, machine readable marks. Later in the semester, many students noticed the boxes on the cover sheet for student identification number, created a four-digit number for themselves, and wrote it into the space provided. Although these numbers were not used in the test processing, they did indicate that the children could probably be trained to mark a designated identification number on the sheets. This would reduce the preprocessing time significantly and would reduce confusions that occur when two students with the same first name do not write their last names on the test sheet.

But there were some problems in scanner use. For instance, as the semester progressed, the quality of pupils' marks seemed to deteriorate rather than improve. Even students in the top groups would slip into making careless marks. Toward the end of the semester, it was necessary for the teachers to re-emphasize the importance of making good marks and to review the procedures for making them. With that emphasis, the marks did improve. The most serious problem in the actual processing of the sheets was jamming of the sheets inside the machine. The incidence of this problem in most scanner operations is normally low, but when the documents are bent and cut on the left corners, folded and crumpled, or when an accumulation of crayon marks and candy smears from sticky fingers works to bind the sheets of a test booklet together, sheet jams become more frequent. To recover from a sheet jam, the operator has two recourses: he can try to force the documents through; if that fails, he must pull the sheets from the feeding mechanism. Often this last recovery procedure tears the input document.

If the input document is torn, a duplicate must be made. For this eventuality, a complete file of blank IMS forms was kept by the scanner. When a sheet jammed and was torn, another sheet with the same format was taken from the file and the responses of the original sheet copied onto the duplicate. To prevent further jams, whenever a sheet was torn in the machine the document feeding path was checked for small scraps of paper.

Another interruption in the processing occurred when a sheet would "select." Because the sequence of the sheets is essential to the interpretation of the data by the computer, a sheet that fails one of the machine checks is "selected" out of the processing stream and stops the processing of the data. It is partially for this reason that the timing mark areas and the format codes are checked out not only by the machine, but also in the preprocessing procedures. It was essential that these areas be read and interpreted correctly, but it was also important that they pass these tests in order to avoid being selected out. When a sheet was selected out, processing had to be stopped, the sheet corrected, the incorrect data card removed from the deck, and the sheet reprocessed. Because of careful preprocessing, sheets were rarely selected because of errors in these areas.

The 1232 operation and related checking procedures did demonstrate several clear advantages. The whole scanner operation could be accomplished in one-third to one-fourth the time required for manual keypunching of test data. Four to seven groups of tests on from 240 to 420 individual sheets of items could be preprocessed and scanned in 1½ to 2 hours, with two people working on the operation. At one point in the semester, when a breakdown of computer programs necessitated doing the work by hand, it took the same people twice as long merely to score the tests without providing any information on how the pupils performed on different objectives.

The number of tests scored for the demonstration does not begin to tax the capacity of the scanner. Coupled with the IBM 534 keypunch, the 1232 can process up to 800 sheets an hour, and thus could accommodate a much larger system.

Computer Processing. The next step in the operational sequence is the running of computer programs to produce printouts. The design specifications of the system required that a report be generated for teachers the morning after each test was administered. It was to contain a summary of group performance by general objective, a listing of recommended remedial work when the group scored below criterion, and an individual listing of pupils' test scores.

There were several minor problems when IMS programs were first instituted. Often these were due to lack of sophistication on some staff members' part about computer programming. For instance, the test writers left some item spaces blank on a page and, quite logically, numbered only those spaces that contained stimuli. However, the computer counts every space, so items had to be manually renumbered. Or, occasionally, a teacher would get a new pupil, give him a test, and send the test for analysis before she had entered the pupil's name and number in the data base. Also, staff members doing the preprocessing assumed that when a child marked all three responses to an item, it would simply be counted as incorrect. However, three marks generated a specific type of card punch, leading to an error in the QUUP program that terminated computer processing. This problem was remedied in the computer programs themselves.

The problems described above were transitory, and the time and quality specifications for printouts were generally met. During the semester the four teachers were provided with approximately 300 routine performance summary printouts for their reading and math groups. From September until December there were only six days when reports were late.

Query System. The last operational component of the system to be discussed in evaluation is the interactive query system. A teletypewriter terminal connected to the Q-32 computer at SDC was installed at each of the participating schools for on-line interactive query on the data base. It was anticipated that the teachers would have questions that were not answered in the daily printout. Through the use of the teletype, questions such as how well a particular child performed on specific objectives could be answered almost instantaneously. Because the teachers were not acquainted with the language of the programs, an operator was available in each school between 12:00 noon and 1:00 p.m. to interpret their questions and get answers from the data base.

Early in the semester, the teachers were receiving so much more detailed information on each child than they normally received that they felt no need for additional data. Also, they were not fully aware of the information that was potentially available. To stimulate questions, the staff members generated sample displays illustrating the types of information the teachers could obtain. With this priming the teachers began to ask for specific information on individual children.

Table 1 shows the number of times the query system was used and the nature of the information provided during the first semester. The most extensive request was by teachers in one school for scores for each student at report card time. Aside from this use for grading purposes, the teletype query was most requested for diagnostic information and parent conferences.

B. TEACHER USE OF IMS DATA

Though IMS has not been tried, evaluated, and revised enough times to bring its mechanical operation to an optimal state, it clearly meets specifications for the first demonstration. Determining its effect upon the classroom is a more difficult problem. Ultimately, evaluation of any classroom innovation must be related to changes in pupil performance. However, IMS only provides data on pupil performance and available resources; the teacher arranges conditions that facilitate pupil achievement of course objectives. Both components of the instructional system, IMS and teacher, must function adequately before a direct effect upon pupil performance can be expected. Until IMS was in operation, teacher use of its resources could not be investigated. Now, after a semester's

Table 1. Use of Teletype

Information Provided Via Teletype	Teacher 1	Teacher 2	Teacher 3	Teacher 4	Total
	No. of TTY Printouts Provided				
Verify up-to-date rosters	6	5	5	5	21
Provide lists of objectives	1	1	1	1	4
Individual scores by major and specific objectives for teacher information and diagnosis	1	2	4	9	16
Parent conferences			3	2	5
Tests missed by specific children	1	1			2
Dates for last group test	1	1			2
Test and major objective scores by tests for grading	1	1			2
Total	11	11	13	17	53

trial, available data can be examined to determine how teachers used IMS information and to generate hypotheses concerning new data, resources, and training that might facilitate teacher performance.

Evaluation of Data Internal to the System. IMS not only provides management data for the teacher, but records many of her instructional decisions in its data base and carefully tracks student performance before and after the decision is made. Even with incomplete data collected this first semester, when all components of the system were under development, a *post hoc* analysis of system data clearly indicates the classrooms in which pupils consistently improved in achievement of objectives and those in which they did not. To illustrate this, scores for three of the ten general reading objectives were recorded for every test that each group took. The three objectives with the lowest initial scores (phonic analysis, sentence comprehension, and paragraph comprehension) were selected because those objectives on which pupils began at near mastery level could show no gain scores. Table 2 presents the first and last in the series of scores for each of the 28 cases where a group finished at least three tests in one of the objectives.

The data are most complete for teachers three and four. Eight times out of nine, the groups in teacher three's class either improved appreciably or stayed within the ceiling score they began on. Teacher four was less successful. In only two of nine cases did her pupils rise appreciably in score. In four cases where they were potentially able to rise, they stayed the same, and in three cases they fell measurably. The data for teachers one and two will not be complete until the end of the second semester, but they appear to be only partially successful. Achievement in teacher one's class rose three times and fell or failed to rise twice. In teacher two's class, achievement rose twice and fell three times. Teachers three and four are at the same school and have apparently similar classes. Teachers one and two are at another school where they share adjoining rooms and also appear to have similar classes.

The scores in Table 2 do not show the great improvement that might have been expected in performance, but they must be examined in the light of other data showing the extent to which the teachers used the IMS report information in making their instructional decisions. These latter data suggest that the teachers as a whole did not use the IMS data as much as they could have. The teacher who did make greatest use of the data, teacher three, is the teacher whose students showed the greatest gains. The following paragraphs discuss in more detail the types of instructional decisions in question, and the data concerning teacher use of the IMS report information.

Teachers in IMS classrooms divide their 30 pupils into three smaller groups to present lessons. This allows increased opportunities for individual attention and for tailoring instructional sequences to children with more homogeneous needs. The teacher is limited in the kinds of day-to-day actions she can take within this instructional system. She can alter lesson pacing, moving more slowly when pupils are having difficulty. She can provide supplemental

Table 2. Initial and Final Scores by Teacher, Group, and Objective.

Teacher	Group	Phonic Analysis	Sentence Comprehension	Paragraph Comprehension
	High	68-77	87-89	[illegible]-81
ONE	Middle	40-57	---	---
	Low	40-22	---	---
	High	88-81	87-73	[illegible]
TWO	Middle	61-48	---	---
	Low	21-42	---	---
	High	95-92	93-96	[illegible]
THREE	Middle	71-97	89-93	[illegible]
	Low	50-64	59-72	75-[illegible]
	High	89-94	[illegible]	[illegible]
FOUR	Middle	72-71	63-75	42-[illegible]
	Low	64-60	57-41	[illegible]

instruction in the form of remedial sequences for the group. She can regroup children so that pupils with similar achievement levels are working together. Finally, she can provide individual instruction to bring a low achiever up to his group's performance. Available data give some indication of how closely IMS teachers followed information provided on progress reports in making these decisions.

Figure 9 provides evidence that all of the teachers alter lesson pacing in relation to the achievement level of their pupils; the higher scoring pupils move faster and the lower scoring pupils move slower. However, the pacing seems to be more closely related to the school than to the actual performance level of the pupils. Classes of teachers one and two completed about the same number of tests, and classes of teachers three and four completed about the same number of tests. This would not have been predicted from the scores, since scores of pupils in teacher four's class were more like those in teacher one and teacher two's classes than those in teacher three's class. The mean number of days between tests for each class reflects this same school difference--4.9 days for teacher one, 4.3 days for teacher two, 2.6 days for teacher three, and 3.4 days for teacher four.

Although the teachers generally paced groups by their test scores, the relationship of days between tests to specific levels of achievement was not always consistent. Table 3 shows the mean number of days between tests by score level for each class. It seems logical that when a group makes a high score on a test, less time will be spent in remedial work and preparation before the next test than when the group makes a low score. If the teacher followed this logic, as the scores in Table 3 decrease, mean numbers of days should increase, with no reversals in the relationship. This was the case only for teachers two and three.

The second type of decision on which information was collected is that of providing supplemental instruction for groups that are not achieving particular objectives. IMS provides for such instruction through the prescription feature of the printout. When a group does not meet the criterion score on an objective, specific follow-up seatwork is recommended to give additional practice in that area. The prescriptions are to be done by the groups independently, following work in the reading circle with the teacher. In addition to IMS prescriptions, the teacher plans exercises of her own to strengthen reading skills and routinely gives them to the children.

In general the printout prescriptions were followed promptly. The teachers stated that when they received the printout they pulled those prescriptions listed from the files, set them aside, and used them during the appropriate period until they were gone. When large numbers were listed (for slow groups, for instance) the children could not always complete them in one day, so there was a carryover. Table 4 shows the total number of prescriptions recommended for each class and the number that each teacher administered.

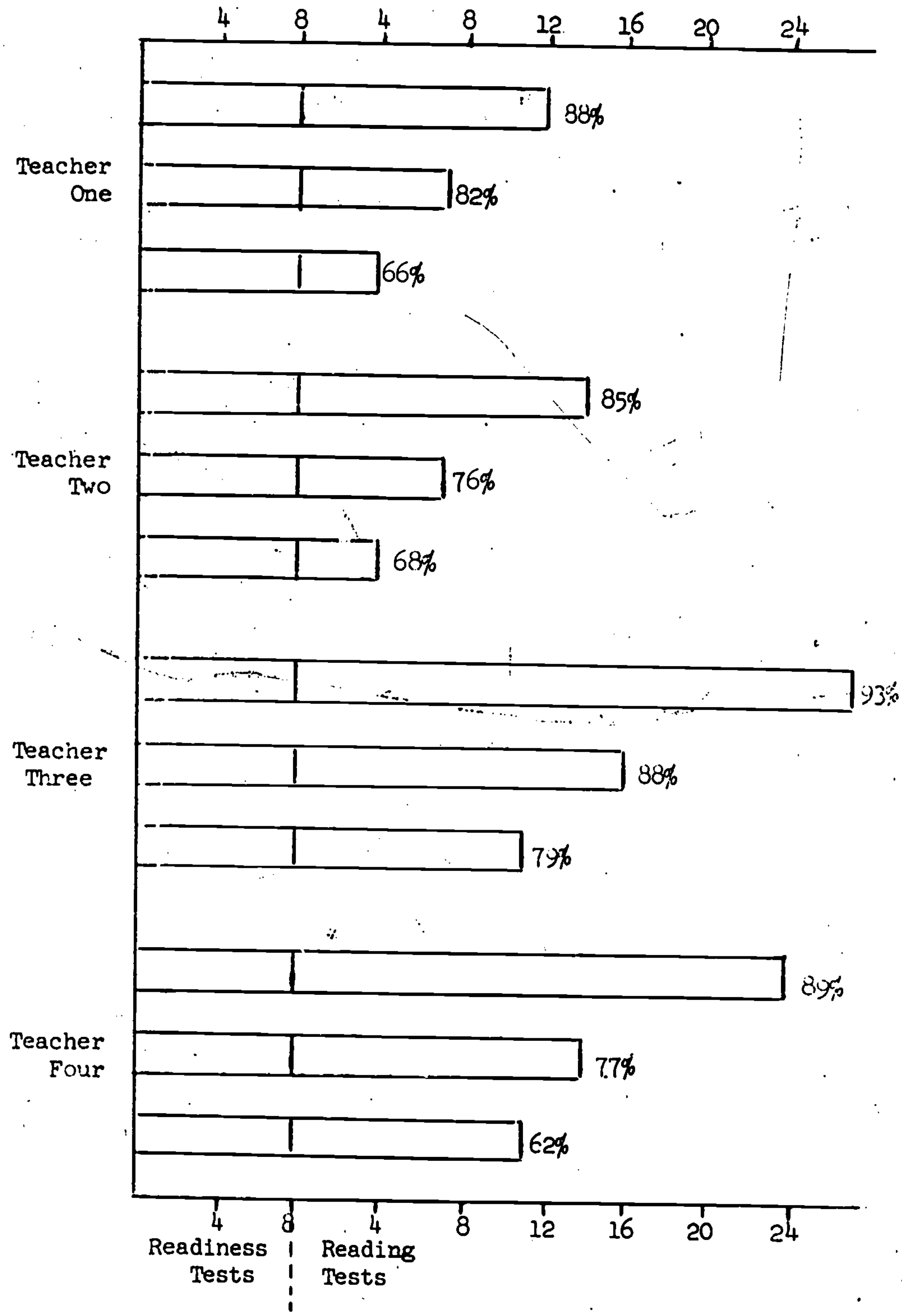

Figure 9. Number of Tests Completed and Cumulative Scores by Reading Groups

Table 3. Mean Number of Days Between Tests by Score Level for Each Class.

	Teacher			
Test Score	One	Two	Three	Four
90-100	4.1	3.0	2.2	2.5
80-89	3.1	3.9	3.5	3.0
70-79	5.4	4.9	3.5	4.2
60-69	3.2	5.0	4.0	2.3
50-59	8.0	5.0	No entries	5.0

Table 4. Teacher Use of Prescriptions

Teacher	Total Number of Group Prescriptions Recommended	Not Given	Percent Given
One	100	19	81
Two	93	5	95
Three	84	9	90
Four	108	29	73
TOTAL	385	62	84

The total number of prescriptions recommended per class ranged from 84 to 108. There were 200 different sets of follow-up materials available in the files, each in sufficient quantities for the three groups. Of those materials prescribed, the number not given ranged from 5 to 29. The percent given ranged from 73 percent for teacher four to 95 percent for teacher two. When questioned, the teachers said they were giving everything prescribed, but there was a small lag at the beginning when the system was getting underway, and there appeared to be oversights along the way. There was also additional use of the nonprescribed follow-up materials keyed to objectives. Teacher three used them extensively and systematically--49 times in addition to the 84 that were prescribed. Teacher one did this also, but only 16 times beyond printout recommendations.

Another measurement related to supplemental instruction was obtained through observation. It was a tabulation of minutes spent providing directions for any period of independent, academically oriented work. The teachers differed somewhat here. On 42 percent of the observed occasions, teacher one spent two minutes or more giving directions before pupils started independent work; teacher two spent that much time on 39 percent of the observed occasions, teacher three on 61 percent of the occasions, and teacher four on 47 percent of the occasions.

The third kind of instructional decision on which we have data is that of regrouping children. Since every IMS printout lists the rank of each child in the teacher's group, it would seem logical for top-ranked children to be moved to higher groups and bottom-ranked children to be moved to lower groups. The change data show that this was not usually the case, except for teacher three who quite consistently followed ranking information in changing children to different groups. Forty-four changes were made during the semester by all teachers. Out of nine changes made by teacher one, in only one case was the bottom-ranked child moved down, and in only two cases was the top-ranked child moved up. For teacher two, in only one case out of ten changes was the top-ranked child moved up, and in no case was the bottom-ranked child moved down. Eleven of the 14 changes made by teacher three were to move top-ranked children up or bottom-ranked children down. In no case out of seven changes did teacher four make this kind of move. Four children not included in this analysis were removed from classroom groups for special treatment.

The last classroom decision activity to be considered is that of providing individual attention to children whose scores are low. Regular IMS printouts identify low achievers by listing total test scores and ranking children within the group. For a teacher to learn on which objective a low-scoring child needed help, she had to query the data base via teletype. Only 16 times was this done by all of the four teachers. In no case did the teachers follow up these requests by asking what prescriptions were available to remedy the low achievement.

The observer also tried to assess the individual attention each teacher provided by counting the number of times each teacher interacted in any way with a low-scoring pupil during reading circle instruction. The range for 20-minute period was from 1 to 15 single interactions, but the only clear pattern was one related to school. Teachers one and two, whose pupils tended to move more slowly through the sequence of lessons, interacted with low-scoring children more often than did teachers three and four. This lack of emphasis on the individual child is not entirely unexpected. Classroom presentations are always in the group mode, so it is logical that the teacher's emphasis more often concerns the action to take with the group rather than with specific children. To effect a change in this attitude, she will probably have to receive automatically more individual information and concrete suggestions for its use.

In addition to analyzing performance scores on tests that are internal to IMS and investigating teacher use of system data, two other techniques were used in evaluation of IMS. One involved administration of an external criterion test at the end of preprimer instruction to IMS pupils and to pupils of comparison schools located in the same general area. The second was a questionnaire administered to teachers twice during the semester in an attempt to gain information on attitudes as well as system operation.

Comparison Test Responses. There were two parts to the comparison test. On the first day children were tested with items that included only vocabulary they had been exposed to in their Ginn series readers. There were four kinds of items: visual discrimination, word recognition, oral word comprehension, and sentence comprehension. Visual discrimination required simple matching of printed words; word recognition required the pupil to select the printed word to match a word that was read to him orally; in oral word comprehension, the pupil selected a picture to show he understood the meaning of a pronounced word; and in sentence comprehension, he read a sentence and selected a picture that illustrated its meaning.

Since the premise of any reading instructional program is that it will train the child to read all words rather than just those he has met in class, a second day's test was administered. Its purpose was to determine how well pupils in IMS reading programs could decode new words when the words involved phonemes the children had been trained on. The test included the same four kinds of items as the first day's test, but the child had not encountered the words in the classroom. Instead, the initial consonants and final portions of words from the first day's test were separated, then recombined to form new words for the transfer vocabulary. For example, the words "fast" and "look" appeared on the first test and the transfer vocabulary word that was tested was "last."

Not all classroom groups completed the preprimer stage of instruction during the first semester; the fact that no low groups were tested was especially critical. Therefore, no statistical analysis was performed on the data, but the scores are presented in Table 5. IMS groups include pupils in the regular Ginn series program of IMS classrooms. Comparison groups include pupils in the Ginn program without the management system. The Ginn plus supplement group was drawn from a class in which, by teacher report, Ginn materials were supplemented by regular phonics drill--direct training on the transfer test task. All of the groups were able to perform on items involving Ginn vocabulary; a statistical test would surely show no significant differences. Performance on the transfer test was much lowever, however, and some differences were apparent. Specifically, IMS pupils performed better than Ginn-only comparison groups on each objective; their range of differences was from four to nine percentage points higher on a task for which neither group had received more than indirect training. However, the Ginn plus supplement group, which received direct training on the task, was obviously superior, being from 2 to 31 points higher on various objectives. The results suggest a hypothesis: combining direct training on a task and a management system to assess that training's effects at each step of the way would provide most effective instruction.

Questionnaire Responses. The questionnaire administered twice during the semester provided some information about how teachers reacted to the management system and how they felt their pupils reacted. The responses were both favorable and unfavorable--difficult to interpret except in a descriptive sense.

The teachers unanimously agreed at mid-semester that the children seemed to enjoy working with the Instructional Management System more than with normal classroom procedures. Reasons given for this were that the earphones and other equipment were new and different from the usual routine and offered a challenge to the pupils. When the same question was asked at the conclusion of the semester, two teachers still said the children enjoyed it more for the same reasons, and two said they enjoyed the new procedures about the same as conventional work. Also mentioned was the point that a group of brighter children in one class became bored toward the end of the semester because they were being tested every day. There had been one comment from a teacher earlier in the semester that her low children did not like to go back to the earphones soon after having taken a difficult test.

Table 5. Comparison Test Data: Ginn Vocabulary

Objective:	IMS Groups N=52	Comparison Groups N=49	Ginn plus Supplement Group N=10
Visual Discrimination	98%	95%	100%
Word Recognition (no context)	98	96	96
Word Recognition (sentence context)	98	98	99
Oral Word Comprehension	93	97	97
Sentence Comprehension	93	87	83

Comparison Test Data: Transfer Vocabulary

Objective:	IMS Groups N=54	Comparison Groups N=50	Ginn plus Supplement Group N=11
Visual Discrimination	96%	92%	99%
Word Recognition (no context)	76	71	94
Word Recognition (sentence context)	76	72	95
Oral Word Comprehension	91	85	93
Sentence Comprehension	52	43	83

The teachers' reactions to IMS were favorable as indicated by some of the following statements. "It has helped me in my work a great deal. It has provided materials and data I normally could not provide." "The system has made it easier to identify learning weaknesses and remedy them through prescriptions." "[It offers]...more accurate diagnosis and assessment of each child's progress for each unit." "[It makes for]...better pacing--not going beyond class' capabilities nor progressing too slowly." "I know exactly what each child is doing and how he compares to his group." "It...helps with grouping and regrouping." "I feel more secure when confronting parents during conferences."

However, the teachers did not feel that these benefits were wholly without cost. Because it was new to them, and a developmental project, there were trials and annoyances. Some teachers were concerned that despite the carrels, children were working together (copying) and talking while at the earphones. Difficulties in keeping track of the test each group should be taking were mentioned, and some teachers said they were made uneasy by having an observer in the room. They considered interruptions or visits made without a scheduled appointment an annoyance. Most teacher suggestions concerned simple mechanics of the system, such as the need for a better filing system for printouts, the need for math prescriptions, the fact that test numbers should be more prominent and easier to find on test booklets, and the desirability of having wireless headsets for presentation of instructions. Some of these suggestions were easy to accommodate and were incorporated into the second semester's system.

VI. CHANGES MADE TO IMS AS A RESULT OF EVALUATION AND REVISION

A. MATERIALS

Appendix A describes the evaluation and revision procedures used in the initial development of IMS tests for the fall 1967 semester. This process, with its many trials and changes to items, was completed before operation of the system began in September 1967. All tests and materials were located in files in the classrooms when school began, to insure that they would be available to the teachers at any point in the semester when they might be needed. Therefore, the design of the tests used in the classes during the first semester was "frozen," and major changes in the tests were not introduced until the start of the second semester. This section of the report gives the rationale for a major second semester revision and describes the changes that were made.

Problems Leading to Revision. Attempts to measure the objectives being taught during each week of first-grade reading instruction revealed several problems in the design of IMS tests and prescriptions. First, testing several objectives required several formats with several sets of instructions. It was difficult to prevent this from becoming so complex that the child could not respond correctly, even when he knew the answer. Second, dividing items a child could complete within 20 minutes among so many objectives meant that most objectives had only a few items; accumulating such items over several tests before judging performance against a criterion implied that the child had not changed during the time between tests. Third, although prescribing remedial work on the basis of nonachievement was a step in the right direction, a single sheet of items based on a single criterion level was probably too crude a prescriptive process to effect many changes in behavior.

Test Reorganization. To alleviate some of these problems, the complete set of reading tests was reorganized. Few items were changed, but many were resequenced so that the number of general objectives occurring on any test was reduced by half. Rather than having many general objectives appearing in every test, they appeared on alternate tests with more comprhensive coverage of specific subject matter. To illustrate, instead of having a test of 34 items spread over from four to seven general objectives, the revised test would use the same number of items to cover only one to three general objectives. Figure 10 shows the item breakdown by test and general objective for the revised tests, and provides data comparable to that of Figure 4 for the original tests.

Advantages to Reorganization. The use of fewer objectives on each test is an aid to test administration. Several of the general objectives are somewhat similar in their format of presentation, but require different pupil behaviors. In empirical trials during development of the reading tests, students would sometimes confuse one set of instructions or format presentation with others, resulting in technical errors. While the revised test will not eliminate this problem, it should reduce the possibility of such confusions.

As mentioned before, a second difficulty with the original reading tests was that of establishing criterion performance. Even when only three or four items were used for the purpose, they had to be accumulated from test to test over several weeks' time. This deferment in establishing criterion also meant delay in prescribing follow-up work. Once again, the revised tests do not eliminate this problem, but they do reduce its frequency of occurrence. To illustrate, on the original tests there were 51 items related to the objective of word recognition that needed to be carried forward to establish criterion. The revised tests have no instances whatever of items being accumulated before criterion is established. Another example is the general objective of phonic analysis involving initial sounds. Instead of combining items from many phonemes on each test, each phoneme is broken out and tested separately. This allows prescriptions to be based on single phonemes--that is, on specific objectives rather than at the general objective level only. Appendix E shows the complete structure for items, by specific objective, for the revised reading tests.

One of the most critical improvements in the revised tests may have to do with the dynamic change in some young children's rate of learning. Suppose a child is tested on a specific objective before criterion is established--let us say that the tests are given in weeks 1, 3, and 5. The resulting score is based on the poor assumption that the child's behavior has not changed between week 1 and 5, and that no new learning has taken place. Because the revised tests do not accumulate items, this problem is eliminated.

Test Number	Visual Discrimination	Word Recognition	Phonics, Initial Sounds	Phonics, Final Sounds	Phonics, Medial Sounds	Structural Analysis	Word Comprehension	Sentence Comprehension	Paragraph Comprehension	TOTALS
1	28									[illegible]
2		14					20			[illegible]
3	21						13			[illegible]
4	15	14		6						[illegible]
5	15		12							[illegible]
6		14				12		[illegible]		[illegible]
7	21						12	[illegible]		[illegible]
8		14	12					[illegible]		[illegible]
9	21						12			[illegible]
10		14	12					[illegible]		[illegible]
11				12					[illegible]	[illegible]
12		14	12					[illegible]		[illegible]
13							12		17	[illegible]
14		14		12				[illegible]		[illegible]
15									[illegible]	[illegible]
16		21		12						[illegible]
17							12		17	[illegible]
18		21	18							[illegible]
19								[illegible]	14	[illegible]
20		21	18							[illegible]
21							12		17	[illegible]
22		14		18				[illegible]		[illegible]
23			18						[illegible]	[illegible]
24		14					[illegible]			[illegible]
25					12				12	[illegible]
26		21						[illegible]		[illegible]
27							12		17	[illegible]
28		28							[illegible]	[illegible]
TOTAL	121	238	102	60	12	12	157	[illegible]	[illegible]	[illegible]

Figure 10. Revised Test Summary: Items Broken Down by Test Number and General Objective.

Problems with Test Reorganization. The reorganization of the reading tests required little change in original content but an almost complete repositioning of items within the tests. This is not in every respect an advantage. For example, the test revision often narrows the time lapse between test and prescription, but it just as often increases the amount of time between instruction and test. When the frequency of testing objectives is reduced to alternate week, every third week, or every fourth week, the tests often do not coincide with classroom instruction. Thus, some items on a test may have been taught several weeks prior to being tested.

Another problem might arise because of concentration of similar items on each test. Some objectives--notably the phonic analysis and comprehension behaviors--give rise to more complex questions than others; scores are usually lower. Concentration of items on these objectives may prove frustrating to less advanced children.

Since the advantages of revision seemed to outweigh the disadvantages, the items were repositioned in reading tests for the second semester. Test performance of the children, classroom behavior during tests, and teacher opinions concerning effects on the changes will be considered in evaluating the revision for the second semester.

B. DATA PROCESSING

Changes Made During First Semester. Three changes of significance were made with respect to the data processing system during first semester operations. The first was a decision to discontinue recording individual test item responses in computer storage. The system was initially programmed to record each student's specific choice on each test item. Because of the exorbitant amount of computer time required to insert these data, because the system had no defined use for this information, and because the records were available on punched cards, it appeared uneconomical to consume computer time for this purpose. It was further reasoned that if someone (such as a test designer) wanted item-specific information, he could perform a special analysis of the data from the records on cards. Consequently, program SSU (see Figure 5) was changed.

The second change was less specific but has rather extensive implications for the future design of IMS. The initial design philosophy for the system provided for an automatically produced, prestructured Progress Report (see Figure 6) that would be generated whenever a test was given to a group of students. In addition, teachers were provided with a computer-linked teletypewriter through which they could compose an almost unlimited variety of reports as the need for them became apparent. In actual practice, however, teachers did not use the interactive capability for three reasons: (1) lack of time; (2) lack of familiarity with the language to compose reports; and (3) the teachers' apparent lack of interest in identifying situations in which such information might help them.

As project members began to realize that the teachers were not initiating action to use the available wealth of information about student performance, changes to the system were tried. The major change was an effort to prepare a computer program that would relieve an interactive user of IMS of much of the burden of composing reports. The program, called IMSOL, interactively queries the user about his information needs and composes reports automatically. One report provides percentage scores for each general objective and each test for a designated student, group, or class. A second provides percentage scores for the specific objectives under a selected general objective for a student, group, or class and for a designated test or test sequence. The third report provides a roster--a listing of students' names and numbers--for a designated group or class. Examples of these reports are found in Appendix G. Because of system problems that occurred in December, IMSOL was not used other than experimentally during the first semester.

A third change in system operations was forced in December when a condition occurred that caused the program IMS to become inoperative. When a specific attempt was made to operate SSU (see Figure 5), this program was concluded by LUCID before it ran to completion. Numerous attempts to continue the program failed. The problem was then turned over to SDC's data base people for study and eventually two errors in the update function of LUCID were found. In the meanwhile, project members turned their attentions to the production of a useful progress report without using the records stored in LUCID. This was accomplished by a listing (produced directly by SSU) that showed each individual student's performance on each of the general and specific objectives. Because the students' records were not available to SSU, the cumulative scores could not be obtained.

Both the experience of relying on teachers to define and obtain information and the system difficulties encountered in December have implications for changes to IMS during the second semester. These changes are discussed in the following section.

Plans for Second Semester. Experience gained during first semester operations enabled project personnel to define several requirements for the version of IMS that will operate during the second semester. Figure 11 illustrates the second semester version.

a. System Efficiency--To reduce the time required to produce the regular progress report, several changes will be made to IMS. The program (SSU) that analyzes and scores tests will be combined with the program (PROG) that produces the progress report so that the report can be made with minimal interaction with LUCID. In addition, the single data base used in the first semester version will be divided into three separate data bases so that interaction with LUCID can be more direct. It is anticipated that these changes will reduce IMS operator time to one-fourth or less of the time required in the previous version.

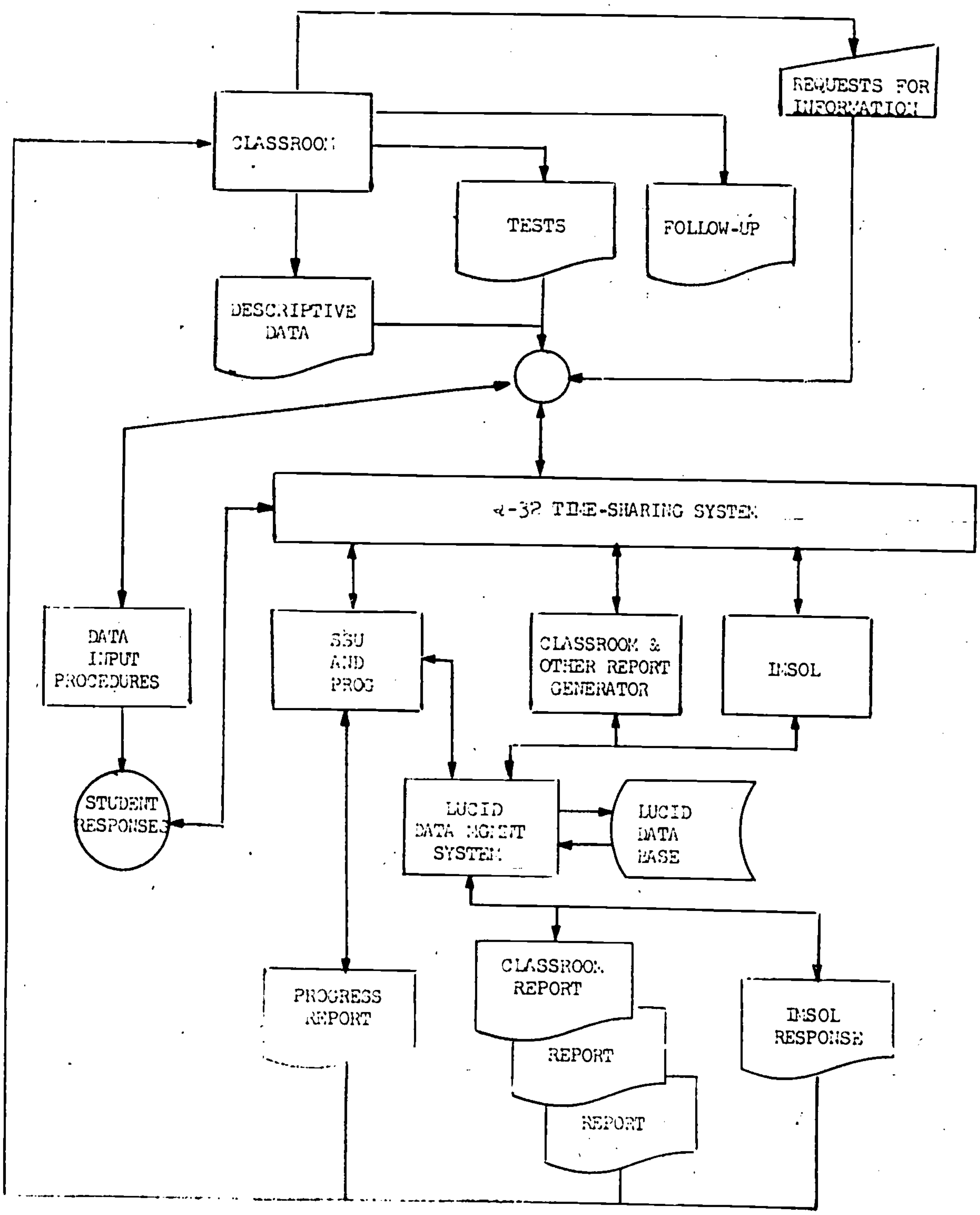

Figure 11. IMS Second Semester Version.

b. Definition of Groups--In the first-semester version, group cumulative scores were defined as the average of all scores obtained by students who had ever been members of a given group (see "Cumulative Score" on Part A, Group Report, Figure 6). Toward the end of the semester, this score contained values carried by some students who were changed to other groups and values of students who had left the school. Consequently, this score was very hard to interpret. In version two, the cumulative score will be calculated as the average of all scores carried by present members of a group.

c. Reports--Figure 12 shows the format planned for the second-semester version of the regular Progress Report. It can be compared with Figure 6, which is the current version. The new version will be produced, as before, when a group of children take a test. The top two lines contain identification information. Under these lines, the information is organized first as a group report. A group score is provided for each of the general objectives tested and for the total test score. As in the first semester version, each general objective score is a composite of several specific objective scores that are not individually tested. Whenever 80 percent of the pupils in the group do not score 80 percent on any of the specific objectives, a code number for a remedial activity is listed under activities recommended. Each code number refers to a sheet of practice exercises stored in folders in a filing cabinet located in each classroom.

In the second part of the report, the information is organized by individual student. Opposite a student's name--on the same line--is his percentage score on this test. Continuing on the same line are the scores made for each of the general objectives covered by this test. Beneath the name of each student, the report shows those specific objectives on which the student failed to attain criterion. The first number identifies the objective. The number in parentheses is the percentage score achieved by the student for the objective. The next entry on this line is the filing cabinet location of follow-up work associated with the objective. A separate line is used for each objective on which the student failed the criterion.

Figure 13 shows a Classroom Summary Report proposed for the second semester. This report will be automatically produced by the system each Friday. During the first semester operations, teachers experienced some difficulty in knowing when students missed tests and in knowing what test a group should next be given. The Summary Report is designed to assist the teacher in both these cases. For a particular date and subject, the report lists children by their group assignment. It shows when a child has taken a test by entering his percentage score under the test sequence number. The absence of a score is shown by dashes. Averages by group by test are included along with the cumulative score for each child. Children are ordered within the group by their cumulative scores. Teachers may wish to post this report in the classroom.

TEACHER 53 DATE 03/19/68 TEST 9909, GREEN BOOK, PP. 55-63
GRADE A1 SUBJECT READING GROUP 3

A. GROUP REPORT

GENERAL OBJECTIVES	SCORE	ACTIVITIES RECOMMENDED
1 VISUAL DISCRIMINATION	86	R9-0109
7 WORD COMPREHENSION	69	R9-0701 R9-0702
TOTAL SCORE	80	

B. INDIVIDUAL REPORT

STUDENT NAME			TOTAL SCORE	GENERAL OBJECTIVES***SCORE THIS TEST 1	7
GEORGE ANDREWS			93	100	83
CHARLES MARTIN			90	95	83
ELAINE NEWMAN			87	95	75
702	(50)	R9-0702			
EVERETT FOSTER			84	100	58
701	(50)	R9-0701			
LOUISE WEBER			78	80	75
109	(71)	R9-0109			
70	(50)	R9-0702			
LEE FREDERICKS			63	71	50
109	(64)	R9-0109			
701	(62)	R9-0701			
702	(25)	R9-0702			
SANDRA WILLIAMS			60	61	58
106	(71)	R9-0106			
109	(57)	R9-0109			
701	(62)	R9-0701			
702	(50)	R9-0702			

Figure 12. Proposed Progress Report for Second Semester Version.

SCHOOL: BRENTWOOD TEACHER: HELEN KING DATE: 02/06/68

SUBJECT: READINESS

TEST NUMBER	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	CUM %
GROUP 1																								
WILLIAM AKERS	100	100	95	80	100	100	00	58																95.
HAL TAFT	90	90	90	80	75	00	--	00																94.
LINDA WEST	--	00	95	90	80	80	100	--																93.
PENNY YOUNG	85	100	--	00	--	76	76	--																92.
ROGER JONES	100	85	80	00	--	43	--	100																92.
CHESTER CHANDLER	90	70	60	--	00	57	00	97																91.
CHRISTINE MEYERS	80	75	95	--	00	95	80	80																90.
VAUGHN BEAMISH	95	85	90	86	90	94	65	75																89.
ALEXANDRIA ZIMMERMAN	100	100	90	100	85	91	63	67																89.
DAVID THOMPSON	90	100	100	90	70	100	94	100																89.
GROUP AVERAGES	91	86	80	100	65	56	87	72																92.
GROUP 2																								
NAME	94	100	90	50	100																			95.
NAME	86	80	90	60	90																			94.
NAME	50	80	85	70	80																			93.
NAME	47	70	85	80	70																			90.
NAME	63	70	100	100	60																			87.
NAME	58	75	100	90	65																			85.
NAME	63	75	---	80	75																			84.
NAME	65	100	---	70	85																			83.
NAME	70	67	00	65	95																			80.
GROUP AVERAGES	80	83	100	80	86																			85.
GROUP 3																								
NAME	80	---																						72.
NAME	70	100																						70.
NAME	60	00																						68.
NAME	80	00																						65.
NAME	85	---																						64.
NAME	40	80																						64.
NAME	20	60																						64.
GROUP AVERAGES	81	75																						65.

Figure 13. Proposed Classroom Summary Report

C. CLASSROOM PRESENTATION EQUIPMENT

Changes Made During the First Semester. One major change was made to presentation equipment during the first semester. The distractions caused by the button-pushing feature of the equipment proved to be the biggest annoyance of the system to the teacher. By the time that the most advanced classes had completed test 8, it had been decided to shift to measured pauses in the place of stops, eliminating the need for button-pushing. Taped lessons were recorded continuously, with estimated response times allowed between instructions. Some samples were tried out successfully, and by the end of November all tapes being recorded were without any stops. The teachers enthusiastically accepted the change, since the less-complicated system required much less supervision on their part.

Changes Made for the Second Semester. The decision to remove stops in the tape recordings eliminated the need for bulky cable bundles and ready boxes, which were not required by a "nonstop" system. Therefore, it was possible to seat children more flexibly throughout the room--rigid carrels were no longer required. For the spring semester, the carrels are portable lightweight pieces of chipboard, covered with a washable vinyl cloth material and supported by notched wood blocks. They can be taken down and set up quickly and easily by students (a very similar design has been successfully used in a kindergarten and first-grade setting for about a year), and different positions or configurations may be set up readily.

Speaker wires for the headsets run around the periphery of the classroom, and jacks are provided at various places where the teacher may want to seat groups of students. By using three-wire cable, we are able to provide the teacher with the ability to have two separate sound sources playing simultaneously, either of which may be selected for any group of students. The teacher will control these sound sources (tape or phonograph) from a table beside her chair.

APPENDIX A

TRIAL AND REVISION CYCLES IN THE DEVELOPMENT OF IMS TESTS

APPENDIX A.

TRIAL AND REVISION CYCLES IN THE DEVELOPMENT OF IMS TESTS

Each IMS test was developed in three atepa, an original test construction and at least two revisiona after the teats were actually administered to subjects. The original test construction included specifying objectives and writing items to measure those objectives at the appropriate point in the instructional program. The first revision cycle included changea to the original test based on analysis of individual trial data. The second revision cycle included changes based on data from group trials of the test. The flow charts of Figures 1, 2, and 3 provide an overview of activities involved in each of the three steps. A further discussion of the test development procedures is presented below.

A. SPECIFYING OBJECTIVES

Even when tests are written for existing instructional programs, the objectives of those programs must be precisely defined. Several guides were available to IMS personnel: publishers' statements, school curriculum guidea, and observations of the instructional activitiea of the claasroom. Detailed instructional objectives were inferred from these sources for each subject area, and sample items were constructed to illustrate each objective. At this point teachers were consulted to discuss objectives and illustrative items. Their suggestions for revision guided rewriting of objectives.

There were two types of objectives: general and specific. The general objectives were broadly defined skills associated with successive levels of content introduced in the first grade. Each general objective was assigned a short title, as listed in Table 1.

Each general objective incorporated a number of specific objectives. In some cases, these represented specific stimulus conditions under which the behavior of the general objective must be exhibited. For instance, the objective called "visual discrimination" largely involved word matching. Specific objectives subsumed under visual discrimination involved matching words when distractors were the same length, had the same beginning letter, etc. In other cases, specific objectives essentially represented content divisions. For instance, the general objective of phonic analysis involved recognition and matching of initial and final consonant sounds in spoken words. The specific objectives were a division of this skill by single letter. A listing of all specific objectivea is provided in Appendix C.

B. INITIAL TEST CONSTRUCTION

The first step in the initial test-writing cycle was the specification of objectives for short units of work. These associated the words or numbers in the pupil's most recent lesson with the broad skills or processes described in

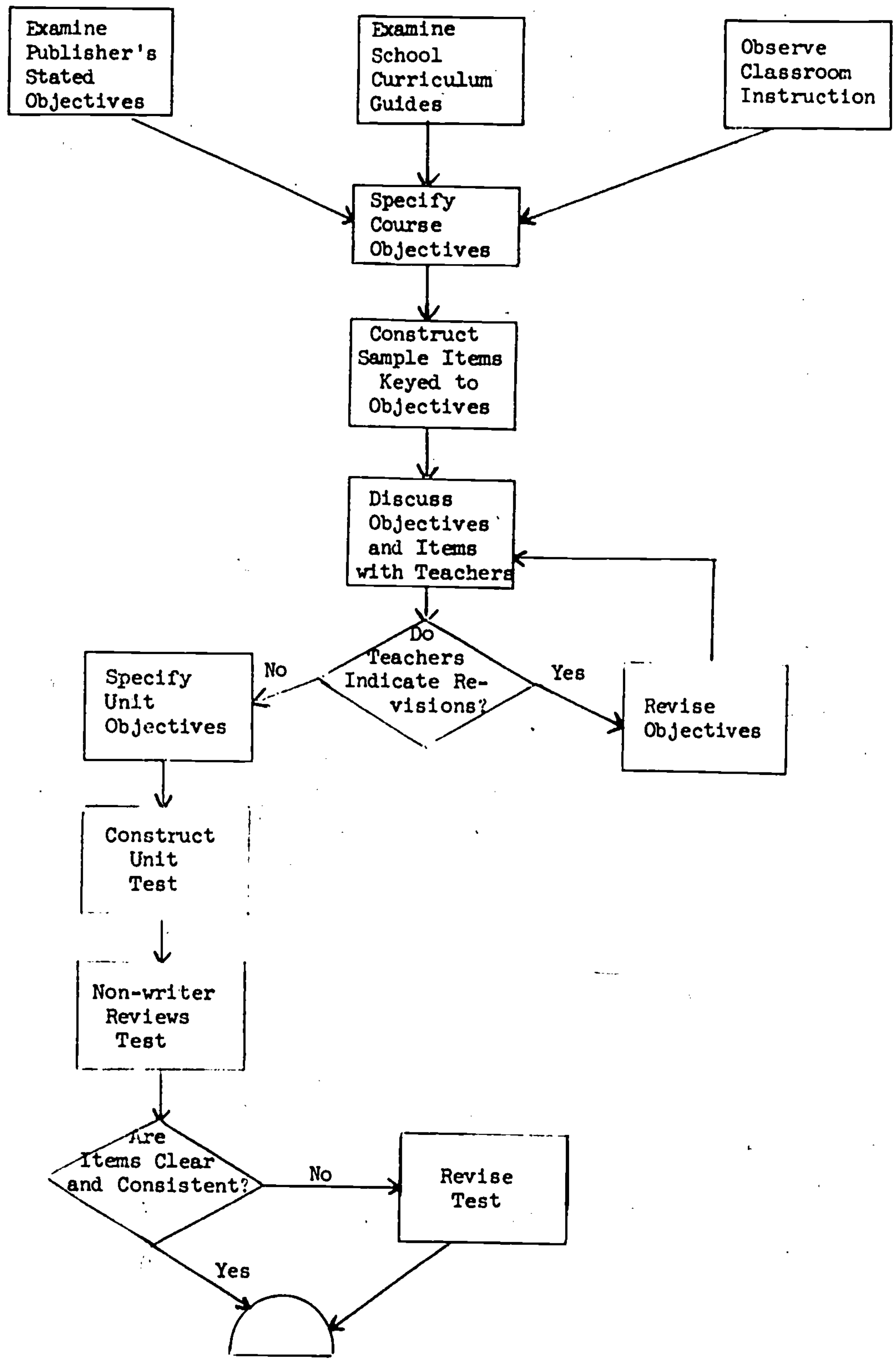

Figure 1. Original Test Construction

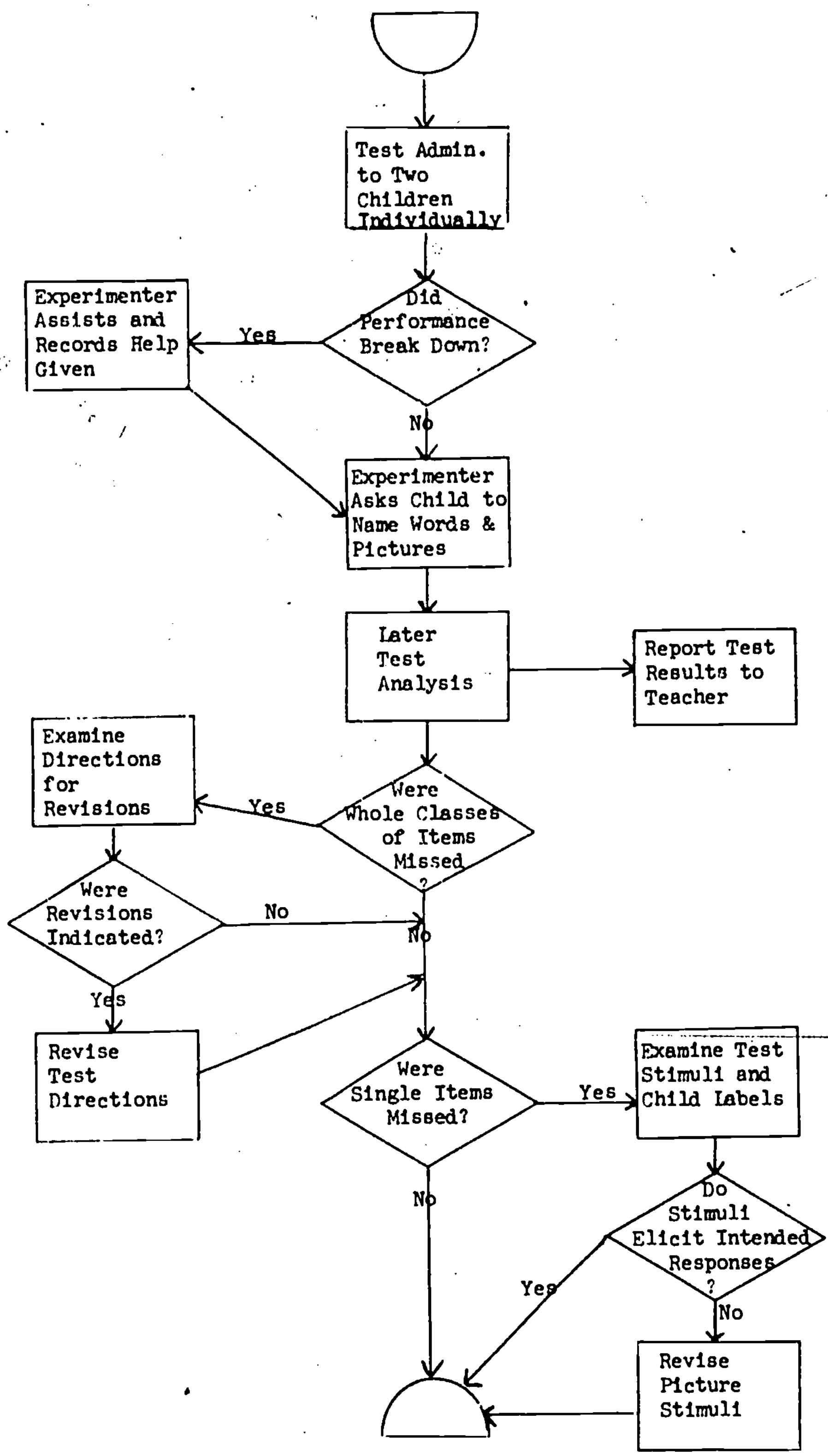

Figure 2. First Test Revision Cycle

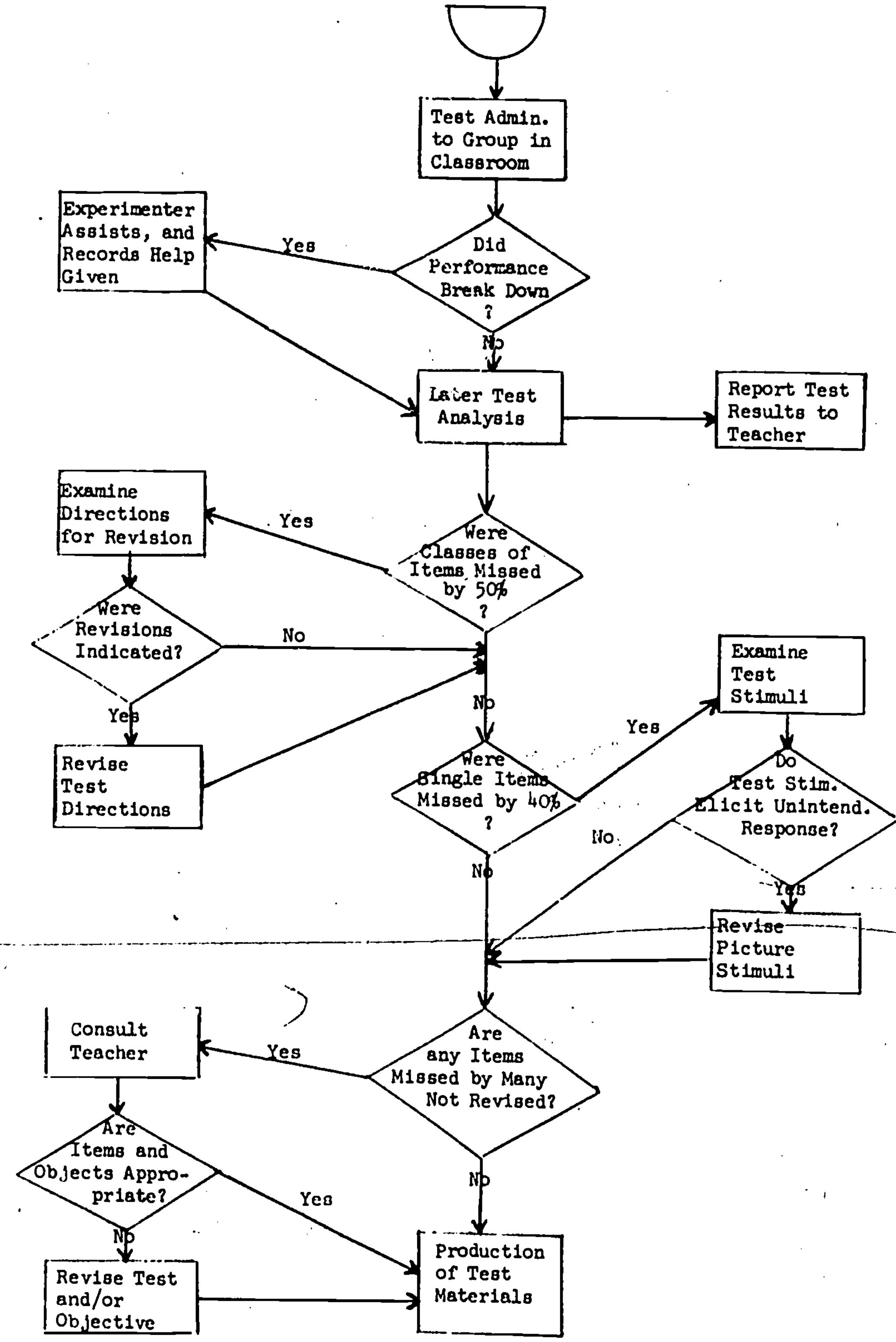
Test Admin. to Group in Classroom
Did Performance Break Down ?
Yes
Experimenter Assists, and Records Help Given
No
Later Test Analysis
Report Test Results to Teacher
Were Classes of Items Missed by 50% ?
Yes
Examine Directions for Revision
Were Revisions Indicated?
No
Yes
Revise Test Directions
No
Were Single Items Missed by 40% ?
Yes
Examine Test Stimuli
Do Test Stim. Elicit Unintend. Response?
No
Yes
Revise Picture Stimuli
No
Are any Items Missed by Many Not Revised?
Yes
Consult Teacher
Are Items and Objects Appropriate?
Yes
No
Revise Test and/or Objective
No
Production of Test Materials

Table 1. List of General Objectives, with Identifying Code Numbers

Readiness

0100	Test Orientation Skills
0200	Visual Matching
0300	Letter-Number Recognition
0400	Word-Phrase Comprehension
0500	Memory Span
0600	Left-Right Progression
0700	Phonic Analysis
0800	Paragraph Comprehension
0900	Ginn Vocabulary

Reading

0100	Visual Discrimination
0200	Word Recognition
0300	Specific Word Confusion
0400	Phonics, Initial Sounds
0500	Phonics, Final Sounds
0600	Phonics, Medial Vowels
0700	Structural Analysis
0800	Word Comprehension
0900	Sentence Comprehension
1000	Paragraph Comprehension
1100	Oral Reading

Arithmetic

0100	Identifying Sets
0200	Matching Equalities
0300	Identifying Inequalities
0400	Addition
0500	Subtraction
0600	Operation Sign
0700	Order of Numbers
0800	Grouping, Place Value
0900	Planes and Plane Figures

the general objectives. Items were then written and arranged in a scannable format for administration.

There were several restrictions in item writing. An obvious one is that the scanner cannot evaluate constructed response items; therefore, multiple choice measurement was used. Another restriction came from the fact that first-grade teachers using a developmental reading approach do not plan their lessons for testing efficiency. They introduce a small number of vocabulary words each week and practice many skills in their context. It is not clear when mastery is expected by all children on particular skills. To test what the teacher was doing during any one week required testing many objectives using many item formats and narrow content.

A third restriction in item writing involved presentation of tests to first graders. Since the pupils cannot read, all directions had to be presented orally and many response positions designated by pictures. Directions were presented by tape recording and both oral directions and ambiguity of pictures became a part of the test item to be quality-controlled in writing.

Working within these limitations, project personnel constructed items for tests, one test at a time. Another person on the staff, not involved in the original test writing, reviewed them for clarity and consistency.

C. FIRST TEST REVISION CYCLE

As the tests were constructed, each one was taken to a school and tried with two children who had completed instruction on skills measured by the test. The children were taken from the classroom to a quiet room and the taped instructions were played aloud. Any problems during the test were noted by the observer. If performance broke down completely, the observer provided any cues necessary to get the child to begin again, and noted these. After each child completed a test, he was asked to name the word and picture stimuli on all pages and was questioned on any incorrect responses to provide information to guide revision. The notes and tests were analyzed. Revisions were made in the tests based upon information obtained from trials with the two children.

D. TEST REVISION CYCLE

The revised tests were then taken into the classroom and administered to a group of six to ten children at a listening center. As before, an observer noted problems during the test. Afterwards, the tests were corrected and items tabulated and analyzed. If 40 percent or more of the group missed a single item, stimuli and directions were again examined for possible sources of ambiguity, and necessary changes were made. Sometimes the tests went through two cycles of group trials before final preparation for printing.

E. TYPES OF REVISIONS MADE TO TESTS AND TEST ITEMS

Many sources of possible ambiguity were discovered in the testing process, and when items were changed to correct these problems, performance usually improved. A log of specific changes on each of the 50 tests was maintained. Analysis of this log during ongoing test writing revealed that most revisions fell into a fairly limited set of categories. When test constructors became alerted to these categories, item writing was greatly facilitated. The categories that were defined were changes to improve: (1) clarity of single stimuli; (2) the relationship of stimuli to others on the page; (3) format; (4) instructions; (5) mechanics of presentation; and (6) content to achieve better balance among objectives measured. These categories are described below.

Clarity of Single Stimuli. Many changes were made in single stimuli in order to make the specified task of any item as clear as possible to the child. Examples of each of these will illustrate the problems involved:

1. Pictures were changed to avoid ambiguity of labels. For instance, a picture of a "jet" may elicit "airplane." Candles on a cake may elicit "birthday cake" or "candles" instead of just "cake." A picture of an owl may elicit "owl" or "bird." An evergreen tree may elicit "Christmas tree." To reduce these confusions, efforts were made to simplify pictures or otherwise make their identity more obvious. Curtains were removed from stimulus pictures of windows when "window" alone was the desired response. Checks and dots were removed from clothing.

2. Pictures on phonic analysis items were changed to maximize differentiation of sound between correct answers and distractors. These items required the child to match a picture to a word from his vocabulary. The child read the word, and the picture was named. The cue for the correct answer was some sound in common. A typical item looked like this (Figure 4):

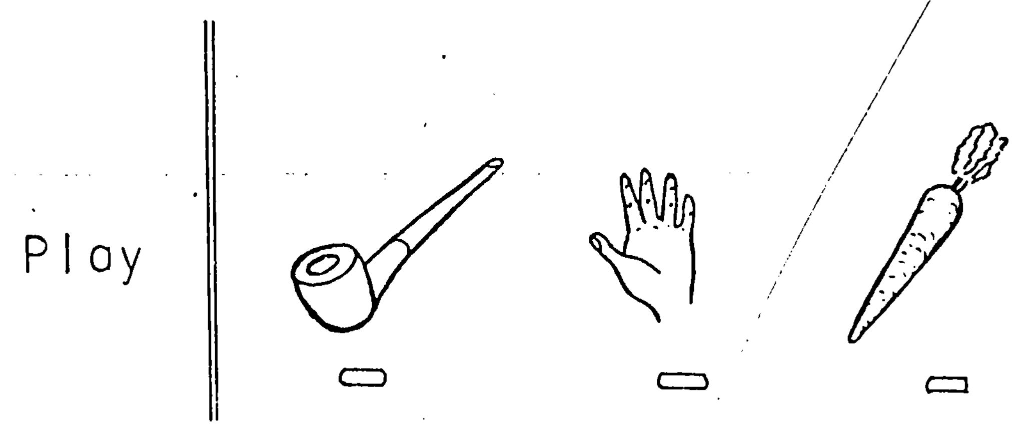

Figure 4.

The child was to match the word "play" with the picture of the pipe; the initial "p" sound was the cue to the correct answer. When a distractor incorporated any similarity of sound, it became a strongly competing stimulus.

When the cue was beginning sound, rhyming distractors of those with the same final or medial sounds were avoided. Thus, all of the following examples (Figure 5), in which the child is to match on initial consonant sound, would be

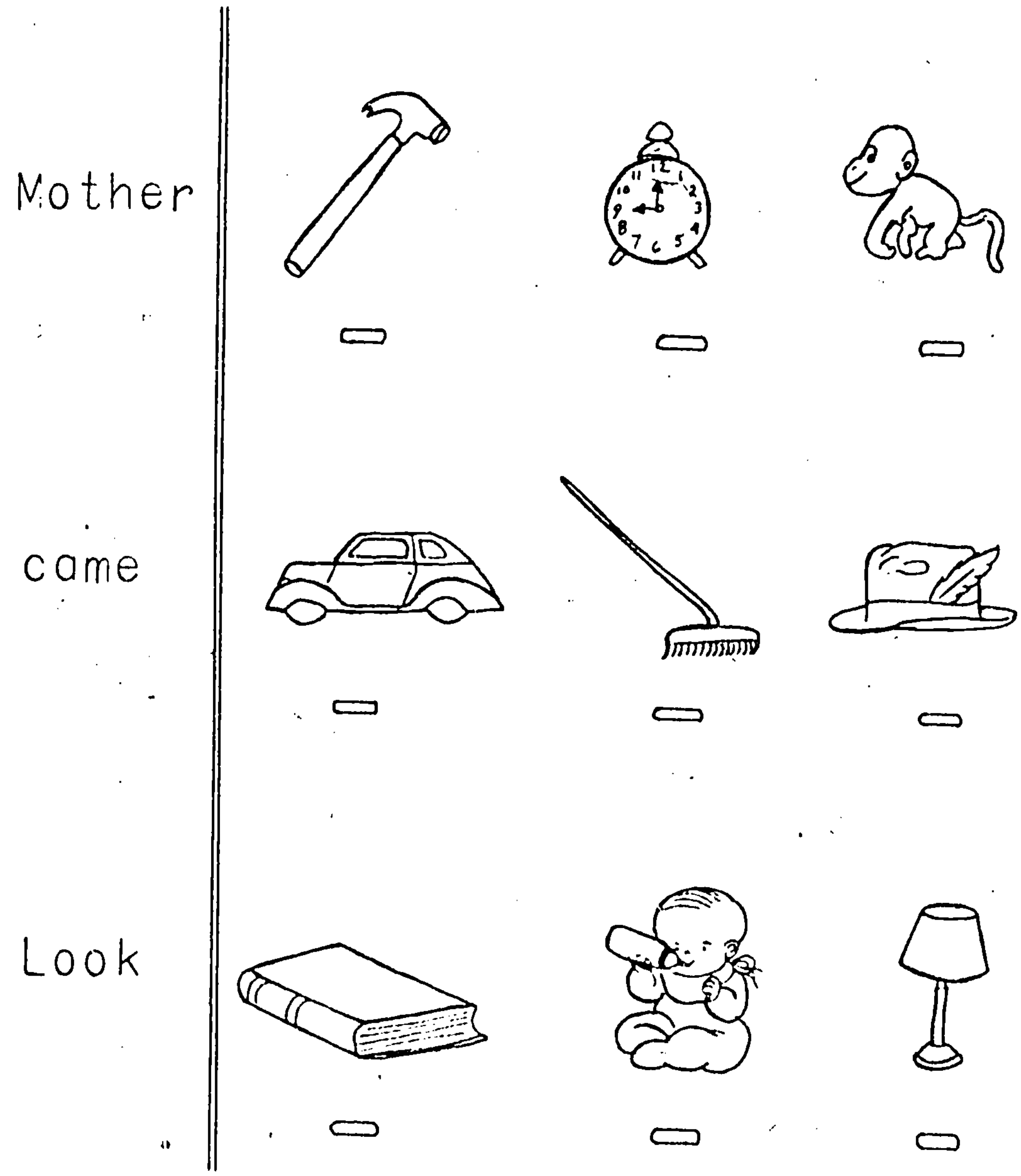

Figure 5.

changed. The hammer in the top row of Figure 5 would be eliminated because of its "r" ending; the rake in the second row would be eliminated because of the medial "a"; and the book in the third row would be eliminated because it rhymes with the stimulus.

3. In like manner, if the child was matching on final sounds, distractors with initial or medial sounds similar to the stimulus word were avoided. If the stimuli were to be matched because they rhymed, again competing sounds had to be eliminated from distractors. Clearly, these items were only treating the first step in development of auditory discrimination. To assess fine discriminations, all the examples that were systematically avoided would have to be systematically included.

4. In several instances, figures or pictures were changed to make the dimension tested more discriminable. If the child was asked to make a size discrimination, the difficulty was reduced by making size differences greater; if completeness (or break in figures) was the cue, the difficulty was reduced by making the break larger.

5. There were changes in figures to eliminate any systematic irrelevant cues. This happened particularly in math items, where pattern, picture content, or set boundary shape were often cueing choices instead of the number dimension. Thus, all of the following examples (Figure 6) would be changed on revision. The correct answer in the first item might be cued by both picture content and set boundary shape. The pattern of the rabbits in the second gives it away, and the boundary shape in the third provides a cue. In revising the items, a careful attempt was made to force attention to the relevant dimension.

6. Use of stimulus and distractors with common relational concepts was avoided. Consider the case where the child is to match a picture of a chicken to the word "chair" using the initial "ch" as the cue. A table would not be used as a distractor, since its relation to chair is too strong. Again, such test items probably <u>should</u> be included later in the sequence, to effect training on finer discriminations.

7. Some pictures were changed to avoid things that are generally unfamiliar to six-year olds in the Los Angeles area. For example, these children do not often play with sleds, and have no use for mittens. These were not used in items.

8. Finally, test constructors had to guard against their tendency to over-use particular stimulus pictures. For instance, a particular fish became very popular for representing the "f" sound, as did one specific monkey for the "m" sound.

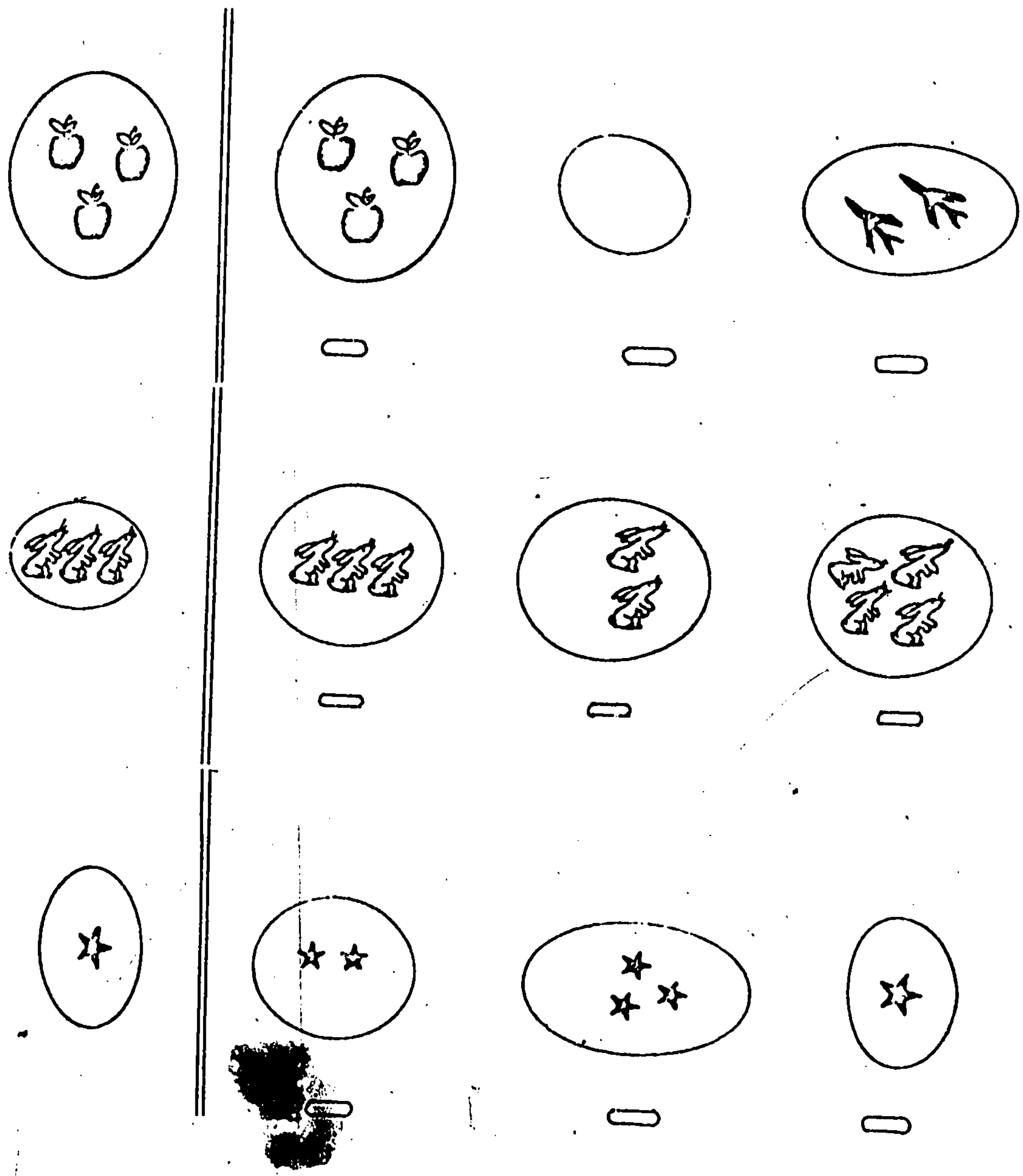

Figure 6.

Relationships of Stimuli to Others on Page. Items were changed because of the ways in which stimuli related to others on a page. For instance, style of drawing had to be consistent, and normal proportions had to be maintained; darker or heavier lines in one picture or a frog that is several times larger than a house in the same item are both unacceptable. The position of the correct response had to be checked and varied to reduce position bias. Items with similar printed stimuli had to be separated by one or more different items to prevent pupils from losing their places.

Changes in Format. Changes in format of the material on the page were made for reasons of clarity, convenience, and economy. Long words were shifted to avoid running them together. They were also shifted to avoid their interfering with response spaces or being too close to timing marks or format code (critical to the scanner operation) on the page.

Where the format type called for responses in a vertical row after comparing words or sentences, the response positions were changed from the left to the right of the printed stimulus. This allowed the child to read from left to right and then mark, thus lessening the possibility of his losing his place.

The number of items on a page was reduced in some cases to fit spacing requirements of IBM scanner sheets. They were also reduced to make the page less complex and easier for the child to respond to, especially in the readiness material and early tests in reading. Where only a few pages of a certain type or format were being used, they were altered to fit a more basic type format to economize on the total number of formats required.

The order of pages in a test was changed to separate pages of items that were alike in format and appearance but that represented different tasks. A page for matching initial consonants looks like one where rhyming is desired; when two such as these are in sequence, it is confusing to a child who may not be listening carefully to the directions.

Changes in Instruction. The need for a change in instructions was recognized most often when a number of pupils made the same kinds of errors on a section of similar items. Changes were often toward simpler vocabulary that the children could more easily understand. There was a reduction in the amount of verbiage to force more responses per instruction (a response for each sentence, if possible).

It was found desirable to add occasional reminders in the instructions to:

- color only one circle in each row;
- finish each page without help;
- indicate when each page is finished;
- put pencils down until it is time to respond.

A major change was to call out, in the taped instructions, the names of the pictures in phonic items. Each child was thus exposed to the interpretation that was intended by the experimenters in as unambiguous a form as possible. Pauses were inserted between the instructions to allow time for marking responses.

When new types of tasks in comprehension were included in the test, a page with a nonscanned sample item was added to introduce each new type and lead the child through to the correct response. Because emergencies sometimes arose, it was found desirable to incorporate into the instructions the procedure for stopping the recorder.

Changes in Content. The most usual reason for changes in content was to allow better balance among objectives in testing. For instance, visual discrimination items (a relatively easy objective) appeared early and were dropped after test 15. Rhyming was dropped after test 17. A more difficult task, phonic analysis on the basis of ending consonants, was added at test 17.

In some instances the time of introduction of new types of test items was changed to limit the introduction of such new types to one per test. One type of sentence comprehension is introduced in test 4, another in test 7. The task of selecting the logical sentence to follow is new in test 8, and story comprehension is new in test 9. In these instances, there was careful sequencing of comprehension items so as to allow earlier introduction of those that appeared easier.

Wording of paragraphs and answer choices in the paragraph comprehension pages was changed so that test questions did not require remembering the textbook story. The content of the paragraph comprehension items was altered so that no paragraphs overlapped in content. The questions themselves were changed in wording to correct the grammar, especially where "who" and "whom" were involved.

Mechanics of Presentation. Finally, the procedures of presentation underwent revision. Early in the group trials, it became apparent that the children were sharing information or copying extensively. There was also a great deal of other interaction, such as talking. To get more reliable results and to reduce copying, U-shaped makeshift carrels were constructed from cardboard file dividers and put into service. The most noticeable difference was that the children were quieter; the copying was cut down greatly and the tests proceeded more smoothly.

Other changes were also made. After working with standard tape recorders for several months, the staff selected simple cartridge-load recorders for the fall installation because they simplified teacher handling. Tests were also controlled to maintain a standard length. All trials were timed and items were deleted when any test took more time to complete than is available in the normal reading period of 20 minutes.

Even after these revisions, some test items were still missed by many children. It was difficult to determine whether this was because the objectives were inappropriately stated, because the items were written poorly, or because the classroom instruction was not teaching the specific skills as intended. The items were again examined, and the teachers were consulted. If, in their opinion, the objectives were inappropriately stated, or the items poorly written, another revision cycle was conducted. Otherwise, the items remained in the test. When cycles of revision were completed for each test, the final form was produced on precisely designed IBM scanner sheets, as described in Appendix B.

APPENDIX B

THE DEVELOPMENT OF SCANNER PROCEDURES AND FORMS

APPENDIX B

THE DEVELOPMENT OF SCANNER PROCEDURES AND FORMS

A. SCANNER FORMATS

Samples of the scanner forms are attached at the end of this appendix. Each form is numbered in the lower left-hand corner. Form 0 is the master cover sheet. Forms 1-8 show the eight basic test formats designed to accommodate the variety of items in the IMS tests.

Specifications for the nine formats were quite rigid. Timing marks, response ovals, and format codes had to be precisely aligned, stripes printed in reflective ink, and sheets consistently of a specified weight and size. These specifications were submitted to SDC's printshop and to independent printers. The lowest bid, one by an outside printer, was accepted. The full order of scanner sheets was received from the independent printer three weeks after the final proofs for the scanner sheets were submitted.

Once the basic scanner formats had been accepted, assembling of the field-tested IMS tests into a scanner format was begun. Thirty-line IBM answer sheets were marked where the response positions on the corresponding sheet formats would be located. Translucent vellum paper was then placed over the layout sheets, and the stimuli for the items were arranged and glued into position on the vellum. These sheets became the vellum masters from which the SDC printers made their plates to print stimuli on test pages. Scanner sheets, reflective ink, and vellum masters of the test materials were then delivered to the SDC printers for the test printing and assembling operation. As the printing of the tests was completed, they were filed in the teachers' filing cabinets; then the cabinets were delivered to the classrooms.

Forms 9 to 12 were designed a little later. They were intended for more specialized use. Three of the four were designed to be general purpose answer sheets, distinguished from the earlier forms by the absence of space for the presentation of stimulus material on the answer sheet itself. The sheets provided response positions for 3-, 4-, and 5-choice multiple choice questions. The last format, Form 12, was intended for the casual user (e.g., a teacher other than the four regular participants), to allow the keying of the items on individual teacher-made tests to numbered objectives. These forms were also ordered from the outside printer, and were delivered in the normal printing period of six weeks. The forms were then divided and delivered to the casual-user files in the teletype rooms at the schools.

B. IMS 1232 OPERATION

As previously mentioned, variable arrangement of response positions across formats prohibited the use of the built-in machine checks on the student mark positions. And yet, some check had to be made on the quality of responses made by the first graders. Earlier, it had been decided that the coding of the student identification number was too important a responsibility to place on first graders. Consequently, a hand preprocessing step was required between the time when the students marked the sheet and the time when the sheets were scanned. In this preprocessing, trained coders identified each student's name from a class roster and coded his number onto the master mark cover sheet. In addition, the coder checked the timing mark and format code area for stray marks and checked the response positions for marks that were too short, too light, or so long that they would generate more than three punches in a card column. Finally, the checker erased marks where the student had crossed out one response and chosen another. These procedures were time consuming but were considered necessary to control the quality of the scanner inputs.

As a further check on the scanning operation, the built-in scanner checks were used to verify the legality of the format codes, to check for stray marks in the timing mark area, and to check the synchronization between the keypunch and the scanner. After scanning, further checks were made on the output deck, including a card count and a comparison of the number of cards to the number of test sheets. A sight check was also made of the identification punches. For each class, student I.D. numbers included the teacher's number coded in the first two digits. By holding the deck to the light, the operator could quickly check to see that each card in the deck for a given testing group had the same teacher number. If the decks were punched correctly, light would pass through the common punches in the first two columns of the I.D. number. This check caught errors both in the coding of the student number and in the operation of the master mark feature.

Finally, the decks were interpreted on an IBM 057 card interpreter, and data punched from the test input form were verified. Because these data were essential in setting the parameters for the processing program, special attention was given to checking their validity. These checks performed on the output decks were quite rapid, and could be performed concurrently with the scanning of data from another group. After passing these checks, the data were taken to an IBM 360/30 and transferred in binary mode to magnetic tape for final processing and input to the system.

APPENDIX C

TEST OBJECTIVES

APPENDIX C

READING READINESS OBJECTIVES

Computer Label	Objective Statement
0100 Test orientation skills	The pupil is able to respond to aural and visual cues of row order and stimulus position in following directions.
0101 Mark rows in no. order	The pupil is able to select a stimulus picture from any numbered row when the stimulus and the row number are named in test directions.
0102 Top, middle, bottom row	The pupil is able to select a stimulus picture from the top row, middle row, or bottom row of a three-row page when the row stimulus is named in test directions.
0103 Little-big side of row	The pupil is able to select a picture on a wider side of a row as opposed to a narrower side when the picture, row, and side of the row are named in test directions.
0104 Mark rows top to bottom	The pupil is able to select a named picture in each row of a six-row page, moving from the top row to the bottom when the directions designate the rows as top row...next row...next row.
0105 Position cue words	The pupil is able to choose the appropriate picture stimulus in a row when directions designate it by its position relationship (first, last, between, right, next to, second, middle, just before, left, in front of, the end of) to other named stimulus in the row.
0200 Visual matching	The pupil is able to select from a row of visual response choices the one that is identical to a printed stimulus.
0201 Content cue	The pupil is able to select from a row the picture that is identical to a stimulus when the choices vary in content.

0202 Detail cue	The pupil is able to select from a row the picture that is identical to a stimulus when the choices differ only in some detail.
0203 Direction cue	The pupil is able to select from a row the picture that is identical to a stimulus when the choices differ only in their spatial orientation.
0204 Size cue	The pupil is able to select from a row the picture that is identical to a stimulus when the choices vary only in size.
0205 Shape cue	The pupil is able to select from a row the abstract figure that is identical to a stimulus when the choices are different geometric shapes.
0206 Abstract fig. - detail cue	The pupil is able to select from a row the abstract figure that is identical to a stimulus when the choices differ only in some detail.
0207 Abstract fig. - direction	The pupil is able to select from a row the abstract figure that is identical to the stimulus when the choices differ only in their spatial orientation.
0208 Size cue - abstract fig.	The pupil is able to select from a row the abstract figure that is identical to the stimulus when the choices vary only in size.
0209 Numerals	The pupil is able to select from a row the numeral that is identical to the stimulus when the choices are numerals or letters.
0210 Lower case letters	The pupil is able to select from a row the lower case letter that is identical to the stimulus when the choices are letters or numerals of similar shape.
0211 Upper case letters	The pupil is able to select from a row the upper case letter that is identical to the stimulus when the choices are letters or numerals of similar shape.

0212	Upper to lower letters	The pupil is able to select from a row the upper or lower case letter that occupies the same alphabetic position as a printed stimulus letter of the opposite case.
0213	Two letter words	The pupil is able to select from a row the two-letter word that is identical to a printed stimulus word.
0214	3+ letter words	The pupil is able to select from a row the word that is identical to a printed stimulus word when the choices are similar words of more than two letters.
0300	Letter-number recog.	The pupil is able to select a named letter or numeral from a row of letters or numerals.
0301	Numerals 0-9	The pupil is able to select a named numeral from a row of numerals.
0302	Capital letters	The pupil is able to select a named capital letter from a row of capital letters.
0303	Lower case letters	The pupil is able to select a named lower case letter from a row of lower case letters.
0400	Word-phrase comprehension	The pupil is able to select a picture from a row which most appropriately illustrates the conditions of a named cue.
0401	Identify activity	The pupil is able to select from a row the picture which most appropriately illustrates a named activity.
0402	Detail of object	The pupil is able to select from a row of similar pictures the one which contains some named detail.
0403	Function of object	The pupil is able to select from the row the pictured object which is appropriate to some named function (i.e., ... the thing you sleep in).

0404 Superlative relationship	The pupil is able to select from a row the picture object which appropriately illustrates a superlative relationship named in the directions (i.e., the biggest dog).
0405 Negation	The pupil is able to select from a row the picture which illustrates a negative relationship named in the directions.
0500 <u>Memory span</u>	The pupil is able to select three named pictures in order, or to select a picture that is identical to an earlier presented stimulus.
0501 Recall 3 named objects	The pupil is able to select a series of three pictures, one from each of three rows in order as named in the directions.
0502 Visual recall-direction	The pupil is able to select a picture that is identical to an earlier presented stimulus from a row of pictures differing only in direction.
0503 Abstract direction	The pupil is able to select an abstract figure that is identical to an earlier presented stimulus from a row of figures differing only in direction.
0504 Abstract shape	The pupil is able to select an abstract figure that is identical to an earlier presented stimulus from a row of figures differing in shape.
0600 <u>Left-right progression</u>	The pupil will begin at the left side of a row and move right in naming or drawing pictures when directions say to start with the "first" or "left" side.
0601 Draw-sequence as named	The pupil will begin at the left side of a row when asked to copy three named pictures.
0602 First-last as left-right	The pupil will select the left picture in a row when asked to choose the "first" picture.

0603 Left-right of page	The pupil will select the left picture in a row when asked to choose the "left" picture.
0700 Phonic analysis	The pupil will select from a row the named picture which has some designated sound similarity to a named stimulus picture.
0701 Same initial consonant	The pupil will select from a row the named picture which has the same initial consonant sound as a named stimulus picture.
0702 Rhyming-distractors vary	The pupil will select from a row of named pictures with no sound similarities in their labels, the one which rhymes with a named stimulus picture.
0703 Rhyming-vowel sound cue	The pupil will select from a row of named pictures with common final consonant sounds in their labels the one which rhymes with a named stimulus picture.
0704 Rhyming-consonant cue	The pupil will select from a row of named pictures with common vowel sounds in their labels the one which rhymes with a named stimulus picture.
0800 Paragraph comprehension	The pupil will select from a row the picture which most appropriately answers questions about a paragraph that has been read or illustrates a sequence that has been described.
0801 Sequence of events	The pupil will select from a row of three pictures of temporally related events the one which answers the question, "What happened first?" or "What happened last?"
0802 Main idea	The pupil will select from a row the picture which most appropriately answers a question about the main idea expressed in a paragraph that has been read to him.

0803	Action sequence	The pupil will select from a row the picture which most appropriately answers a question about the sequence of events in a paragraph that has been read to him.
0804	Recall details	The pupil will select from a row the picture which answers a question relating to details of a paragraph that has been read to him.
0805	Drawing conclusions	The pupil will select from a row the picture which most appropriately represents a conclusion which can be drawn from a paragraph that has been read to him.
0900	Ginn vocabulary	The pupil can match the printed words or pictured objects and characters taken from given preprimer one to each other or to their names aurally presented.
0901	Word recognition	The pupil can select from a row a word that has been named in directions.
0902	Select named objects	The pupil can select from a row a picture that has been named in directions.
0903	Match word to picture	The pupil can select from a row the picture which illustrates a printed stimulus word or the word which names a stimulus picture.

APPENDIX C

READING OBJECTIVES

Computer Label	Objective Statement
0100 Visual Discrimination	The pupil is able to select from a row of printed response choices the one that has the same cue as a printed stimulus.
0101 Lower case letters	The pupil is able to select from a row of lower case letters the one that is identical to a printed stimulus letter.
0102 Capital letters	The pupil is able to select from a row of capital letters the one that is identical to a printed stimulus letter.
0103 Caps to small letters	The pupil is able to select from a row of capital or lower case letters the one that has the same alphabetic position as a printed stimulus letter of the opposite case.
0104 Two letter words	The pupil is able to select from a row of two-letter words the one that is identical to a printed stimulus word.
0105 Maximum difference words	The pupil is able to select from a row of words that are different in length and in most letters, the one that is identical to a printed stimulus word.
0106 The same length words	The pupil is able to select from a row of words that are alike in length but different in most letters, the one that is identical to a printed stimulus word.
0107 First letter distractor	The pupil is able to select from a row of printed words with the same initial letters, but differing final letters, the one that is identical to a printed stimulus word.
0108 Final letter distractor	The pupil is able to select from a row of words with the same final letters, but differing in initial letters, the one that is identical to a printed stimulus word.

0109	Many letter distractors	The pupil is able to select from a row of words that have several letters of varying positions in common, the one that is identical to a printed stimulus word.
0110	Long words	The pupil is able to select from a row of words all more than seven letters long, the one that is identical to a printed stimulus word.
0111	Initial letter cues	The pupil is able to select from a row of words that have no particular letter or length control, the one which has the same initial letter as a printed stimulus word.
0112	Caps to non-cap words	The pupil is able to select from a row of capitalized or non-capitalized words with no particular letter or length control, the same word as a printed stimulus word which has an initial letter of the opposite case.
0113	Word in sentence context	The pupil is able to select from printed words in a sentence one which is identical to a printed stimulus word.
0114	Sentences-beginning same	The pupil is able to select from three printed sentences that have the same initial words one that is identical to a printed stimulus sentence.
0115	Sentences-ending same	The pupil is able to select from three printed sentences that have the same final words one that is identical to a printed stimulus sentence.
0200	<u>Word Recognition</u>	The pupil is able to select from a row of printed response words the one that is the same as an aural stimulus word.
0201	Maximum difference words	The pupil is able to select from a row of printed words that are different in length and in most letters, the one that is the same as an aural stimulus word.
0202	Same length words	The pupil is able to select from a row of printed words with the same number of letters, the one that is the same as an aural stimulus word.

0203 Initial letter distractor	The pupil is able to select from a row of printed words with initial letters the same, the one that is the same as an aural stimulus word.
0204 Final letter distractor	The pupil is able to select from a row of printed words with final letters the same, the one that is the same as an aural stimulus word.
0205 Many letter distractors	The pupil is able to select from a row of printed words which have several letters of varying positions in common, the one that is the same as an aural stimulus word.
0300 <u>Specific word confusion</u>	The pupil is able to select the correct printed response word from a row of very similar words to match a printed, pictured, or aural stimulus.
0301 Betty, Bunny	The pupil is able to appropriately select as a matching response to a printed, pictured, or aural stimulus, the printed word "Betty" or "Bunny" from a row of words which includes the other.
0302 can, and	The pupil is able to appropriately select as a matching response to a printed, pictured, or aural stimulus, the printed word "can" or "and" from a row of words which includes the other.
0303 surprise, something	The pupil is able to appropriately select as a matching response to a printed, pictured, or aural stimulus, the printed word "surprise" or "something" from a row of words which includes the other.
0304 airplane, apple	The pupil is able to appropriately select as a matching response to a printed, pictured, or aural stimulus, the printed word "airplane" or "apple" from a row of words which includes the other.
0305 house, home	The pupil is able to appropriately select as a matching response to a printed, pictured, or aural stimulus, the printed word "house" or "home" from a row of words which includes the other.

0702 "s" form of verbs — The pupil is able to select from a row of printed verbs, some plural, and others singular formed by adding an "s," the one which correctly completes a blank left in a printed stimulus sentence.

0703 "ed" past tense of verbs — The pupil is able to select from three printed sentences that are alike except for verb tense, the one which most appropriately continues the meaning of a printed stimulus sentence.

0800 Word comprehension — The pupil is able to select from a row of pictures the one for which a printed stimulus label is most appropriate, or to select from three sentences the one which continues the meaning of a stimulus sentence.

0801 Picture and noun label — The pupil is able to select from a row of pictures of objects the one which depicts the meaning of a printed noun label.

0802 Picture and verb action — The pupil is able to select from a row of pictures of figures in action the one which depicts the meaning of a printed verb stimulus.

0803 Picture and description — The pupil is able to select from a row of pictures illustrating descriptive words the one which most appropriately depicts a printed stimulus word.

0804 Picture-position word — The pupil is able to select from a row of pictures illustrating some position relationship the one which most appropriately depicts a printed stimulus word.

0805 Picture - "not" phrase — The pupil is able to select from a row of pictures the one which most clearly illustrates a negatively stated stimulus sentence.

0806 Use of pronouns — The pupil is able to select from a row of pictures the one which most appropriately depicts the meaning of a stimulus pronoun; or to select from a list of sentences differing only in pronoun the one which correctly refers to an antecedent noun in a ~~stimulus~~ sentence.

0807	Color words	The pupil is able to select from a row of pictured objects the one whose typical color is the same as a printed color word stimulus.
0808	Knowledge of characters	The pupil is able to select from a row of pictured characters the one which is named by a printed stimulus word.
0900	Sentence comprehension	The pupil is able to select from three response choices a sentence in which all words are in correct sequence and are related appropriately in content and structure, or select a picture which appropriately illustrates the meaning of a sentence.
0901	Content cues	The pupil is able to select the correctly worded sentence from three response choices, two of which have a single word which is not appropriate to the content meaning of the sentence.
0902	Structural cues	The pupil is able to select the correctly worded sentence from three response choices, two of which have a single word which is not appropriate to the content meaning or grammatic structure of the sentence.
0903	Word sequence	The pupil is able to select from three response choices the picture which most appropriately illustrates the meaning of a printed stimulus sentence.
1000	Paragraph comprehension	The pupil is able to select from three printed sentences the one which most appropriately continues the meaning of a printed stimulus sentence or to select from three pictures the one which most appropriately answers a question about a printed stimulus paragraph.
1001	Sentence relationships	The pupil is able to select from three printed sentences the one which most appropriately continues the meaning of a printed stimulus sentence.
1002	Main ideas	The pupil is able to select from three pictures the one which correctly illustrates the main idea of a printed stimulus paragraph.

1003 Sequence of action	The pupil is able to select from three pictures the one which correctly answers a question about the sequence of action in a printed stimulus paragraph.
1004 Details	The pupil is able to select from three pictures the one which correctly answers a question about some detail of the paragraph.
1005 Inferences	The pupil is able to select from three pictures the one which illustrates the most probable inference to be drawn from a printed stimulus paragraph.

APPENDIX C

MATHEMATICS OBJECTIVES

Computer Label	Objective Statement
0100 Identifying Sets	The pupil is able to select from a row the set which is identical to a pictured stimulus set, or matches an auditory or printed numeral description of the set.
0101 1 to 1 Correspondence	The pupil is able to select from a row the set which has a number of pictured objects equal to the number of objects in a pictured stimulus set.
0102 Empty set	When directions tell the pupil to "find the empty set," he is able to select from a row of sets enclosed in circle boundaries the set with no objects.
0103 Numeral value of sets	The pupil is able to select from a row the set which has a number of pictured objects equal to a printed stimulus numeral.
0104 Phrase describing sets	The pupil is able to select from a row the set which has a number of pictured objects equal to a printed numeral phrase stimulus.
0105 Set with most members	When directions tell the pupil to "find the set with the greatest number of things," he is able to select from a row the set with the greatest number of pictured objects.
0106 Nonequivalent set	When directions tell the pupil to "find the set that does <u>not</u> have the same number of things as the other two sets," he is able to select from a row the set with the non-equivalent number of pictured objects.
0107 Set with 1 more, 1 less	When auditory directions tell the pupil to "find the set of (<u>some number</u>) and one more," he is able to select from a row the set with the number of pictured objects equal to this phrase.
0108 Set with least members	When the pupil is asked to "find the set with the least number of things," he is able to select from a row the set with the least number of pictured objects.

0200	Matching Equalities	The pupil is able to indicate equality between numerals, numeral phrases, and words by matching those that are equivalent or appropriately selecting the = symbol to express equivalent relationships.
0201	Number, symbols/words	The pupil is able to select from a row the printed numerals or words that are equal to each other.
0202	Phrase/numeral	The pupil is able to select from a row the printed numeral phrases and/or numerals that are equal to each other.
0203	Supplying =	The pupil is able to select the = symbol when it appropriately expresses the relationship between two sides of an equation and reject > and < symbols.
0300	Identifying Inequalities	The child is able to appropriately identify inequality relationships by correctly selecting the greatest or least value numeral or supplying inequality symbols to express nonequivalent relationships.
0301	> or < Symbol	The child is able to select the > or < symbol when it appropriately expresses the relationship between two sides of an equation and reject the = symbol.
0302	Greatest-value numeral	The child is able to accurately select from a row the greatest numeral when auditory directions ask him to do so.
0303	Lowest-value numeral	The child is able to accurately select from a row the least numeral when auditory directions ask him to do so.
0400	Addition	The pupil is able to add three-numeral sums and equate two-numeral and three-numeral addition phrases.
0401	Equations, placeholders	The pupil is able to select from a row the numeral which would accurately fill a square placeholder to complete a sum in an equation.

0402	Associative property	The pupil is able to select from a row a two-numeral addition phrase (i.e., 5 + 3) which is equivalent to a three-numeral addition phrase in a printed stimulus.
0403	Aud. stim-sums to 10	The pupil is able to select from a row the sum for an auditorily presented two-numeral addition problem.
0404	Vertical sums	The pupil is able to select from a row the sum of a column of numerals presented in a printed stimulus.
0500	<u>Subtraction</u>	The pupil is able to subtract a smaller number from a larger within the limits of one to ten.
0501	Equations, placeholders	The pupil is able to select from a row the numeral which would accurately fill a square placeholder to complete a difference in an equation.
0502	Auditory stimulus	The pupil is able to select from a row the numeral which represents the difference in a horizontally printed stimulus problem.
0503	Vertical subtraction	The pupil is able to select from a row the difference between two numerals in a vertically printed stimulus problem.
0600	<u>Operation Sign</u>	The pupil is able to select the printed addition or subtraction symbol (+ or -) which would correctly fill a placeholder to complete a printed stimulus.
0601	Supply +, - for equation	The pupil is able to select the printed addition or subtraction symbol (+ or -) which would correctly fill a placeholder to complete a printed stimulus equation.
0700	<u>Order of Numbers</u>	The pupil can identify numerals missing from a series of pictured objects corresponding to ordinal words.
0701	Numeral order	The pupil can select from a row the numeral which is missing for a series of printed stimulus numerals.

0702	Ordinal words, 1st-10th	The pupil can select from a row the pictured object which corresponds to an auditorily presented ordinal word.
0800	<u>Grouping, Place Value</u>	The pupil is able to identify the number of tens and the number of ones in a two-digit numeral.
0801	Sets of tens and ones	The pupil is able to select from a row the two-digit numeral which corresponds to pictured sets of tens and ones.
0802	Phrase and two-digit no.	The pupil is able to select from a row the two-digit numeral which corresponds to a printed word and numeral phrase describing its tens place value and ones place value.
0900	<u>Planes and Plane Figures</u>	The pupil can identify common two-dimensional geometric forms and the inside and outside of such forms.
0901	Identify geometric shapes	The pupil can select from a row of printed responses the common geometric form that is named in directions.
0902	In-, outside geometric shapes	The pupil can select from a row of printed responses the geometric figure which has a dot inside or outside its area as named in directions.

APPENDIX D

PLACEMENT OF ITEMS ON FIRST

SEMESTER TESTS

APPENDIX D

First Semester Placement of Items by Specific Objective and Test*

READING TEST OBJECTIVES

General Objective #1--Visual Discrimination--Matching Two Visual Stimuli

Obj.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	Total
1						2	1	2								5
2					1		4	1						2	2	10
3						1	1	2	2		7			2	2	17
4			7										7	2	2	18
5		7					3	1	1	1				2	2	17
6	7			4			2	1					7			21
7							3	1	2	1						7
8																
9							3	2	1							6
10																
11																
12												7				7
13																
14																
15																
16																
17																
18																
19																
20																
21																
22																
23																
24																
25																
26																
27																

*General Objectives VI and VII are represented by very few specific objectives; therefore no appendix chart is provided.

READING TEST OBJECTIVES

General Objective #II

Word Recognition--Matching a Printed Word to a Pronounced Word

Test	Maximally Different Words	Words of Same Length	Words With Initial Letters Same	Words With Final Letters Same	Words With Several Letters Same	Total Items
1		2	1	2		5
2		1	3	1		5
3			2	2	2	6
4			2	2	1	5
5			3		4	7
6	1	3	2	1		7
7		1	2	3	1	7
8			4	1	2	7
9			3	2	1	6
10		2	2	2	1	7
11		2	4		1	7
12			3	2	2	7
13			2	3	2	7
14			3	3		6
15		1	3	1	2	7
16		3	6	1	2	12
17		2	6	3	3	14
18		3	3	3	5	14
19		1	4	6	3	14
20			7	3	4	14
21		2	4	4	4	14
22		2	6	6		14
23			4	1	2	7
24		1	3	2	1	7
25			4	3		7
26		2	2	2	1	7
27			3	2	2	7

READING TEST OBJECTIVES

General Objective #III--Specific Vocabulary Confusions

Test # \ Obj.	301	302	303	304	305	Total
1	7					7
2		4				4
3		2				2
4	1	1				2
5		1				1
6						
7						
8						
9		2				2
10						
11						
12						
13						
14			1			1
15						
16		1			1	2
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						

READING TEST OBJECTIVES

General Objectives #IV--Phonic Analysis--Determining Initial Consonant Sounds

Test / Obj.	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	Total
1	1	2	2	2	3																	10
2		1	3	1	1	3	2															11
3	1			1	1		1	1	1													6
4	1	1	1			2			1													6
5																						
6			1		2				1		1	1										6
7		1	1	1	1						1								1			6
8		1	1						1	1	1	1										6
9																						
10			1	1					1	1	1	1										6
11	1			1				1	1				1	1								6
12				1			1				1		1	1			1					6
13																						
14																						
15																						
16				2		1	1		1								1					6
17																						
18	1	1		1			1								1							6
19				1	1			1			1						1	1				6
20	1		1	1	1			1		1												6
21			1	1			1									1			1		1	6
22																						
23	1			1		1	1			1				1								6
24																						
25																						
26																						
27	1				1					1	1	1				1						6

Figure 3. Second Test Revision Cycle

READING TEST OBJECTIVES

General Objective V--Phonic Analysis--Determining Final Consonant Sounds

Test # \ Obj.	501	502	503	504	505	506	507	508	509	510	511	Total
1									3			3
2												
3												
4												
5									6			6
6												
7												
8									6			6
9									6			6
10												
11									6			6
12												
13									6			6
14									6			6
15									6			6
16												
17									6			6
18												
19			1		3				1	1		6
20												
21												
22	1		1		2		1	1				6
23												
24												
25		1	1			1		1		1	1	6
26												
27												

READING TEST OBJECTIVES

General Objective #VIII--Word Comprehension

Test # Obj.	801	802	803	804	805	806	807	808	Total
1		2	1					5	8
2	1							7	8
3	3							3	6
4									
5									
6								7	7
7	5	1					6		12
8									
9	4	2							6
10									
11			3	2				1	6
12									
13	3			1					4
14	1	2	1	2			6		12
15									
16									
17	6								6
18									
19									
20	4					6			10
21	3	2		1					6
22	3	2		1					6
23	2	3				5			10
24	2	2	1	1					6
25	3	1			2				6
26	1	1		4					6
27	3	2				5			10

READING TEST OBJECTIVES

General Objective #IX--Sentence Completion

Test # \ Obj.	901	902	903	904	Total
1					
2					
3					
4				3	3
5				3	3
6				3	3
7	1	3			4
8			4		4
9			4		4
10			4		4
11					
12			4		4
13					
14			4		4
15			4		4
16					
17					
18			4		4
19					
20	4				4
21	4				4
22	4				4
23					
24					
25	4				4
26	2	2			4
27	1	3			4

READING TEST OBJECTIVES

General Objective #X--Paragraph Comprehension

Obj.	1001	1002	1003	1004	1005	Total
1						
2						
3						
4						
5						
6						
7						
8	4			2	1	7
9				4	2	6
10	4		2	4		10
11	4	1	1	4		10
12	4			4	2	10
13	4			4	2	10
14	4			2	1	7
15	4			5	1	10
16	4	1		3	2	10
17		1		3	2	6
18			1	4	1	6
19	4		1	3	2	10
20				1	2	3
21	4			3		7
22		1		4		5
23				4	2	6
24	4			5	1	10
25				4	2	6
26	4			5	1	10
27				2	1	3

(Page 2 blank)

APPENDIX E

PLACEMENT OF ITEMS ON

SECOND SEMESTER TESTS

APPENDIX E

Second Semester Placement of Items by Specific Objective and Test

READING TEST OBJECTIVES

General Objective #1--Visual Discrimination-Matching Two Visual Stimuli

Test # \ Obj.	100	101	102	103	104	105	106	107	108	109	110	111	112	113	Total
1	28	7	7											7	49
2															
3	21					5	4	5	7		7	4	4		57
4	15										7	4	4		30
5	15							7				4	4		30
6															
7	21				7		7				7				42
8															
9	21						7			14					42
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
21															
22															
23															
24															
25															
26															
27															
28															

READING TEST OBJECTIVES

General Objective #II

Word Recognition--Matching a Printed Word to a Pronounced Word

Test # / Obj.	0200	0201	0202	0203	0204	Total
1						
2			4	6	4	14
3						
4			4	4	6	14
5						
6		5	5		4	14
7						
8			6	4	4	14
9						
10			5	4	5	14
11						
12			6	4	4	14
13						
14			4	5	5	14
15						
16		4	8	4	5	21
17						
18		4	7	5	5	21
19						
20			6	7	8	21
21						
22			8	6		14
23						
24			6	4	4	14
25						
26			9	7	5	21
27						
28			11	10	7	28

READING TEST OBJECTIVES

General Objective III--Phonic Analysis--Determining Initial Consonant Sounds

Test # / Obj.	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	Total
1																	
2																	
3																	
4																	
5		6	6														12
6																	
7																	
8				4	4	4											12
9																	
10			4				4		4								12
11																	
12										4	4	4					12
13																	
14																	
15																	
16																	
17																	
18										4			4	4		6	18
19																	
20		4						4							4	6	18
21																	
22																	
23				4					4		4					6	18
24																	
25																	
26																	
27																	
28																	

READING TEST OBJECTIVES

General Objective IV--Phonic Analysis--Determining Final Consonant Sounds

Test # \ Obj.	401	402	403	404	405	406	407	408	409	410	411	Total
1												
2												
3												
4	6											6
5												
6												
7												
8												
9												
10												
11	12											12
12												
13												
14	12											12
15												
16	12											12
17												
18												
19												
20												
21												
22		18										18
23												
24												
25												
26												
27												
28												

READING TEST OBJECTIVES

General Objective V--Phonic Analysis--Determining Medial Consonant Sounds

Test #	Obj. 0500	0501*
25		12

General Objective VI--Identifying Plural Words (Structural Analysis)

Test #	Obj. 0600	0601*
6		12

*Each of these objectives is only represented on one test.

READING TEST OBJECTIVES

General Objective VII--Word Comprehension

Test #	Obj. 0700	0701	0702	0703	0704	0705	0706	0707	0708	Total
1										
2							20			20
3		4					9			13
4										
5										
6										
7								12		12
8										
9		8	4							12
10										
11										
12										
13		5	7							12
14										
15										
16										
17		4	4	4						12
18										
19										
20										
21		4	4		4					12
22										
23										
24		6	7	4	9					26
25										
26										
27		7	5	6						18
28										

READING TEST OBJECTIVES

General Objective VIII--Sentence Comprehension

Test #	Obj. 0800	0801	0802	0803	Total
1					
2					
3					
4					
5					
6				6	6
7				6	6
8			8		8
9					
10			8		8
11					
12		4			4
13					
14			8		8
15					
16					
17					
18					
19		4	4		8
20					
21					
22		8			8
23					
24					
25					
26		12			12
27					
28					

READING TEST OBJECTIVES

General Objective IX--Paragraph Comprehension

Test #	Obj. 0900	0901	0902	0903	Total
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11			11	1	12
12					
13		8	5	4	17
14					
15		8	8	4	20
16					
17		8	5	4	17
18					
19		8	3	3	14
20					
21		8	6	3	17
22					
23			6	3	9
24					
25			6	6	12
26					
27		8	6	3	17
28			6	3	9

APPENDIX F

SYSTEM INPUT FORMS

SCHOOL ROSTER

School No.	School Name	Principal's Name	School Phone

STUDENT ROSTER

TEACHER NO.________ TEACHER NAME________________ GRADE________

SCHOOL NO.________ SCHOOL NAME________________

Student No.	Student Last Name	Student First Name	Grade

TEACHER ROSTER

SCHOOL NO.________ SCHOOL NAME________________

Teacher No.	Teacher Last Name	Teacher First Name	Mr./Mrs./Miss	Room No.	Grade

COURSE DESCRIPTION OUTLINE

AUTHOR NO. ( ): ________ SUBJECT NO. ( ): ________ GRADE LEVEL ( ): ________

Objective No. ( )				General Objective Name ( )
		0	0	( )
				Specific Objective Names ( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )
				( )

TEST DESCRIPTION FORM

Test No. ( ) [| | |]

SUBJECT NO. ( ): ____________ GRADE LEVEL ( ): ____________

TEST NAME ( ): (______________________________)

Objective Number ( )	Test Item Numbers ( )	Criterion ( )	Sum From Test No. ( )	Prescription ( )
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,
	, , , , , , , , , , , ,			, , , , ,

Input Form 2: Test Description Form

APPENDIX G

INTERACTIVE QUERY REPORTS

IMS ON-LINE QUERY PROGRAM - IMSOL

The IMS On-Line Query program has been designed to allow querying of the IMS data bases in a manner more oriented to the needs of the IMS users, rather than in a general purpose manner such as QUUP provides.

The following displays are presently available:

Display #1, General Objective Scores, provides percentage scores by objective and by total test for a student, a group or a class over several tests with the scores cumulated or listed by test.

Display #2, Specific Objective Scores, provides scores for specific objectives under a general objective for a student, a group or a class over several tests with the scores cumulated.

Display #3 doesn't exist.

Display #4, Group or Class Roster, provides a list of student numbers and student names for a group or a class.

Following is a guide to the contents of this document:

LOGGING IN AND LOADING

User: LOGIN XE3Ø18G1216
TSS: $OK LOG ON XX

LOGIN identifies the user to the time-sharing system, TSS. The user types the word 'LOGIN' followed by two numbers; the first number is the "man number" or "project number" and the second number is the "work order number" or "share number."

The TSS response includes the TTY channel number on which the user has logged.

User: LOAD IMSOL
TSS: $LOAD XX

LOAD requests TSS to load IMSOL (or any user-designated program). The user types the word 'LOAD' and 'IMSOL.' If the program is not on disc TSS will request a tape number (IMSOL is stored on reel number 1920)
$RPEAT LOAD CMND WITH REEL NUMBER
LOAD IMSOL 1920

User: GO

TSS: $MSG IN.

GO activates IMSOL and transfers control from TSS to IMSOL. The user types the word 'GO.'

IMSOL is now the controlling program, and to communicate with the user IMSOL will print a message on the TTY followed by an asterisk. The user must wait until the asterisk appears before replying.

IDENTIFYING THE DATA BASE, TEACHER, GRADE, AND SUBJECT

IMS: INSTRUCTIONAL MANAGEMENT SYSTEM - IMS

At this point TKQUP, a procedurized version of QUUP, is read in. If it is not found on disc it is read in from tape #2053 and the following messages printed:
IMS ROUTINES BEING LOADED FROM TAPE
$WAIT
$FILE TKQUP DRIVE XX REEL 2053

IMS: IDENTIFY INPUT DATA BASE.
User: USE 12/13/67 DISC IMSDA

The user types the word 'USE' followed by the name of the data base (the date the data base was last updated) followed by the word 'DISC' followed by the disc name, IMSDA.
If the data base is not found on disc, the following message is printed on the TTY:
DISC ID NOT IN INVENTORY.
IDENTIFY INPUT DATA BASE.
The user would then type the word 'USE' followed by the data base name, as above, followed by the word 'TAPE' followed by the tape reel number, 1007.
The TSS will respond with:
$WAIT
$FILE DBINPT DRIVE XX REEL 1007
IMS will then respond with:
100 PERCENT OF INPUT ON DISC

IMS: ENTER TEACHER NO.
User: *6

The user types the teacher number to which the succeeding display requests will apply.

IMS: ENTER GRADE
User: *B1

The user types the grade to which the succeeding display requests will apply.

IMS: ENTER SUBJECT NO.
User: *1

The user types the subject number to apply to the succeeding display requests; no. 1 is Reading.

IMS: BUILDING BRENTWOOD
TEACHER SARAH BURGESS DATE 12/20/67

REQUESTING GENERAL OBJECTIVE SCORES

IMS: ENTER DISPLAY NO.
User: *?
IMS: 1 GENERAL OBJECTIVE SCORES
2 SPECIFIC OBJECTIVE SCORES
3
4 GROUP OR CLASS ROSTER

If the user does not know what displays are available, he may type a question mark '?' in response to the request to enter a display no.

IMS: ENTER DISPLAY NO.
User: *1

The user enters display no. 1, General Objective Scores.

IMS: FOR A STUDENT, GROUP OR CLASS S/G/C
User: *S

The user enters an 'S' for a student.

IMS: ENTER NAME
User: *JOHN HAWTHORNE

The user enters the student's name, first name followed by last name.

IMS: ENTER TEST NOS.
User: *9901

The user requests General Objective Scores for a single test.

IMS: STUDENT JOHN HAWTHORNE DATE 12/20/67
SUBJECT B1 READING TESTS 9901-9901

TOTAL SCORE	******PERCENT SCORE BY OBJECTIVE****** 1	2	3	4	5	6	7	8	9	10
93	100	100	71	100	100			87		

REQUESTING GENERAL OBJECTIVE SCORES (Cont'd)

IMS:	ENTER DISPLAY NO.
User:	*1
IMS:	FOR A STUDENT, GROUP OR CLASS S/G/C
User:	*S
IMS:	ENTER NAME
User:	*JOHN HAWTHORNE
IMS:	ENTER TEST NOS.
User:	*99Ø1 - 9916
IMS:	SCORES BY TEST OR CUMULATED T/C
User:	*T

In this case, the user is requesting the General Objective Scores for more than one test with the scores to be printed out for each test taken.

IMS: STUDENT JOHN HAWTHORNE DATE 12/2Ø/67
SUBJECT B1 READING TESTS 9901-9916

TEST NO	TOTAL SCORE	******PERCENT SCORE BY OBJECTIVE****** 1	2	3	4	5	6	7	8	9	1Ø
99Ø1	93	1ØØ	1ØØ	71	1ØØ	1ØØ			87		
99Ø3	89	94	66	1ØØ	1ØØ				83		
99Ø4	87	94	1ØØ	1ØØ	83			83		33	
99Ø5	67	88	42	1ØØ		5Ø				33	
9912	94	1ØØ	1ØØ		1ØØ					1ØØ	8Ø
9913	75		85			1ØØ		1ØØ	75		5Ø
9914	75		83	1ØØ		1ØØ			58	1ØØ	57
9915	85	85	85			1ØØ				75	8Ø
9916	73		58	1ØØ	1ØØ						7Ø

REQUESTING GENERAL OBJECTIVE SCORES (Cont'd)

IMS: ENTER DISPLAY NO.
User: *1
IMS: FOR A STUDENT, GROUP OR CLASS S/G/C
User: *S
IMS: ENTER NAME
User: *JOHN HAWTHORNE
IMS: ENTER TEST NOS.
User: *9901 - 9916
IMS: SCORES BY TEST OR CUMULATED T/C
User: *C

This request is identical to the previous request except that the scores will be cumulated over all tests taken.

IMS: STUDENT JOHN HAWTHORNE DATE 12/20/67
SUBJECT B1 READING TESTS 9901-9916

TOTAL SCORE	******PERCENT SCORE BY OBJECTIVE******									
	1	2	3	4	5	6	7	8	9	10
83	92	77	86	97	88		87	73	72	68

REQUESTING GENERAL OBJECTIVE SCORES (Cont'd)

IMS:	ENTER DISPLAY NO.
User:	*1
IMS:	FOR A STUDENT, GROUP OR CLASS S/G/C
User:	*G
IMS:	ENTER NAME
User:	*BRONTOSAURUS
IMS:	ENTER TEST NOS.
User:	*9901 - 9916
IMS:	SOCRES BY TEST OR CUMULATED T/C
User:	*T

This request is for the General Objective Scores, by test, for a group named Brontosaurus.

IMS: GROUP BRONTOSAURUS DATE 12/27/67
SUBJECT B1 READING TESTS 9901-9916

TEST NO	TOTAL SCORE	******PERCENT SCORE BY OBJECTIVE****** 1	2	3	4	5	6	7	8	9	10
9901	97	97	100	94	95	95			98		
9902	96	96	100	96	94				98		
9903	96	96	90	100	100				98		
9904	96	96	94	100	100			95		95	
9905	95	94	95	100		100				90	
9906	96	96	91		92				100	100	
9907	94	95	93		97				100		
9908	94		98		94	96				93	86
9909	93	100	91	75		95			95	96	85
9910	89		96		100					90	78
9911	90		91		93	95			100		80
9912	87	100	91		100					75	74
9913	92		95			97		100	100		82
9914	91		85	85		97			97	89	83
9915	96	97	93			95				100	95
9916	80		73	64	100						68

REQUESTING SPECIFIC OBJECTIVE SCORES

IMS: ENTER DISPLAY NO.
User: *2
IMS: FOR A STUDENT, GROUP OR CLASS S/G/C
User: *S
IMS: ENTER NAME
User: *JOHN HAWTHORNE
IMS: ENTER TEST NOS.
User: *9901
IMS: ENTER OBJECTIVE NO.
User: *3

The user has requested display no. 2, Specific Objective Scores, for a student for a single test. The specific objective requested is no. 3, Specific Word Confusion.

IMS: STUDENT JOHN HAWTHORNE
SUBJECT B1 READING TESTS 9901-9901 DATE 12/20/67

OBJECTIVE 3 SPECIFIC WORD CONFUSION

SPECIFIC OBJECTIVE	POSSIBLE ATTAIN.	STUDENT ATTAIN.	PERCENT
BETTY, BUNNY CAN, AND SURPRISE, SOMETHING AIRPLANE, APPLE HOUSE, HOME WANT, WHAT SUSAN, SURPRISE	7	5	71

IMS: ENTER ANOTHER OBJECTIVE NO. FOR THIS DISPLAY
User: *NONE

The user could have entered another objective no., in which case the specific objective names and scores for that objective no. would be printed out followed by a request for another objective no. for this display. When no more specific objective scores are desired, the user should enter 'NONE.'

REQUESTING SPECIFIC OBJECTIVE SCORES (Cont'd)

IMS:	ENTER DISPLAY NO.
User:	*2
IMS:	FOR A STUDENT, GROUP OR CLASS S/G/C
User:	*S
IMS:	ENTER NAME
User:	*JOHN HAWTHORNE
IMS:	ENTER TEST NOS.
User:	*99ø1 - 9916
IMS:	ENTER OBJECTIVE NO.
User:	*9

The user has again requested a display for Specific Objective Scores for a student. This time, however, the scores will represent the performance over several tests.

IMS: STUDENT JOHN HAWTHORNE DATE 12/2ø/67
SUBJECT B1 READING TESTS 99ø1-9916

OBJECTIVE 9 SENTENCE COMPREHENSION

SPECIFIC OBJECTIVE	POSSIBLE ATTAIN.	STUDENT ATTAIN.	PERCENT
CONTENT CUES			
STRUCTURAL CUES			
WORD SEQUENCE	12	11	91
PICTURE AND SENTENCE	6	2	33

IMS:	ENTER ANOTHER OBJECTIVE NO. FOR THIS DISPLAY
User:	*1ø

IMS: OBJECTIVE 1ø PARAGRAPH COMPREHENSION

SPECIFIC OBJECTIVE	POSSIBLE ATTAIN.	STUDENT ATTAIN.	PERCENT
SENTENCE RELATIONSHIPS	2ø	14	7ø
MAIN IDEAS	4	4	1øø
SEQUENCE OF ACTION			
DETAILS	15	9	6ø
INFERENCES	7	5	71

IMS:	ENTER ANOTHER OBJECTIVE NO. FOR THIS DISPLAY
User:	*NONE

After having requested a second set of scores for objective 10, the user indicates that he needs no more data for this student over these tests.

REQUESTING SPECIFIC OBJECTIVE SCORES (Cont'd)

IMS: ENTER DISPLAY NO.
User: *2
IMS: FOR A STUDENT, GROUP OR CLASS S/G/C
User: *G
IMS: ENTER NAME
User: *BRONTOSAURUS
IMS: ENTER TEST NOS.
User: *9914
IMS: ENTER OBJECTIVE NO.
User: *2

This request is for Specific Objective Scores for test 9914 for a group named Brontosaurus, with Objective 2 being requested first.

IMS: GROUP BRONTOSAURUS DATE 12/27/67
SUBJECT B1 READING TESTS 9914-9914

OBJECTIVE 2 WORD RECOGNITION

SPECIFIC OBJECTIVE	POSSIBLE ATTAIN.	GROUP ATTAIN.	PERCENT
MAXIMUM DIFFERENCE WORDS			
SAME LENGTH WORDS			
INITIAL LETTER DISTRACTOR	21	18	85
FINAL LETTER DISTRACTOR	21	18	85
MANY LETTER DISTRACTORS			

IMS: ENTER ANOTHER OBJECTIVE NO. FOR THIS DISPLAY
User: *8

IMS: OBJECTIVE 8 WORD COMPREHENSION

SPECIFIC OBJECTIVE	POSSIBLE ATTAIN.	GROUP ATTAIN.	PERCENT
PICTURE AND NOUN LABEL	7	7	1ØØ
PICTURE AND VERB ACTION	14	14	1ØØ
PICTURE AND DESCRIPTION	7	7	1ØØ
PICTURE-POSITION WORD	14	14	1ØØ
PICTURE-'NOT' PHRASE			
USE OF PRONOUNS			
COLOR WORDS	42	4Ø	95
KNOWLEDGE OF CHARACTERS			

IMS: ENTER ANOTHER OBJECTIVE NO. FOR THIS DISPLAY
User: *NONE

REQUESTING A GROUP OR CLASS ROSTER

IMS:	ENTER DISPLAY NO.	
User:	*4	
IMS:	FOR A GROUP OR CLASS	G/C
User:	*G	
IMS:	ENTER NAME	
User:	*BLUE	

The user has requested display no. 4, a Group or Class Roster, for a group named Blue. (The sample display is for teacher no. 55.)

IMS: GROUP BLUE 12/2∅/67
SUBJECT B1 READING

STUDENT NO.	STUDENT NAME
55∅2	MICHAEL BOVA
55∅6	LISA DENBAUGH
55∅9	GINA GONZALES
5513	BILLY MCKINNEY
5516	BENNY NEEDHAM
5523	CINDY SZELESTEY

REQUESTING DISPLAYS FOR ANOTHER SUBJECT OR TEACHER

IMS: ENTER DISPLAY NO.
User: *NONE

If the user wishes to obtain displays about another subject or another teacher, type 'NONE' in response to the enter display no.

IMS: MORE DISPLAYS FOR TEACHER NO. 6 Y/N
User: *Y

In this case, the user wishes additional displays about teacher no. 6, but wishes to change the subject matter.

IMS: ENTER SUBJECT NO.
User: *5

The user requests subject no. 5, Math.

IMS: ENTER DISPLAY NO.
User: *

The user may now continue requesting displays for teacher no. 6 for Math.

IMS: ENTER DISPLAY NO.
User: *NONE

Again the user types 'NONE' in order to request another teacher no. or subject no.

IMS: MORE DISPLAYS FOR TEACHER NO. 6 Y/N
User: *N

This time the user wishes to change teacher no.

IMS: OTHER TEACHER'S DISPLAYS Y/N
User: *Y

If the answer here had been 'N' instead of 'Y' the program would have concluded. $PGM CONCLUDED

IMS: ENTER TEACHER NO.
User: *

IMS: ENTER GRADE
User: *

IMS: ENTER SUBJECT NO.
User: *

After the user answers these requests the teacher heading is printed and then a display no. is requested, and the user is ready to proceed further.

IMS: BUILDING BRENTWOOD 12/20/67
TEACHER'

IMS: ENTER DISPLAY NO.
User: *

INTERACTING WITH THE TIME-SHARING SYSTEM

A. SPECIAL SYMBOLS

! The exclamation point is used to initiate communication with TSS.

" The quotation mark is used to initiate communication with IMSOL (or any user program that has been loaded).

cr The carriage return transmits the TTY input. All inputs must end with a carriage return in order for communication to take place.

$ The dollar sign precedes all messages from TSS.

The exclamation point and quotation marks perform another function. If the user wishes to cancel a message he has typed before it has been transmitted, i.e., before he hits the carriage return key, he may use either the exclamation point or quotation mark. This will cancel the message and institute a carriage return.

B. SPECIAL REQUESTS

The following requests to TSS can be made without being logged in as a user, except for SEARCH. If the user has been communicating with IMSOL and wishes to make a request to TSS, he must precede his request with an exclamation mark. Note that once a TSS request is made, it places the user in communication with TSS; the quotation mark must be used to revert to communication with IMSOL.

!DIAL 9 (followed by a message)
Whatever message follows the DIAL 9 request is transmitted to the computer operator. Each line of the message must be preceded by the DIAL 9 request. TSS indicates that a line of input has been transmitted by responding with $MSG IN.

!DRUMS
TSS responds with the number of contiguous words of drum space available; 34956 WDS AVBL

!TAPES
TSS responds with the number of available tape drives; $3 TAPES AVLBL

!SEARCH FOR (disc inventory name)
TSS will respond with $NOT FOUND or $ON DISC ONLY, and information about the disc file.

!QUIT
TSS responds with $MSG IN. and usually with TTY will be turned off.

!STATUS

Following are some of the statuses of the TTY channel the user is using:

$NO LOGIN

The user has not yet logged in.

$NOT LOADED

The user has not yet loaded IMSOL.

$WAITING FOR GO

The user has loaded the program, but has not typed 'GO'

$WAITING FOR TAPE

The computer operator has not yet mounted a requested reel.

$WAITING FOR TTY

The user has not answered the last request by IMSOL or IMSOL did not receive the answer. Repeat the answer, making sure communication is with the program by preceding the answer with the quotation mark.

$PROGRAM STOPPED

Typing 'GO' will again activate the program.

$PGM OPERABLE

$BTCH QUEUE POSN xx

The program is waiting for its turn under time sharing.

$PROD STACK POSN xx

The program is waiting for its turn under time sharing.

C. SPECIAL REPLIES

$?
$N/A
$WHAT
$ILLEGAL COMMAND

TSS does not recognize the response made by the user. Generally this happens when the user wishes to respond to IMSOL, but has been communicating with the TSS and has not preceded the program response with a quotation mark.

D. A SAMPLE INTERACTION WITH TSS

User: !STATUS

TSS: $NO LOGIN

User: LOGIN XE3Ø2 G1216

TSS: $ WORK NR ILLEGAL

User: LOGIN XE3Ø1 G1216
TSS: $OK LOG ON 2Ø 11:Ø4.9 12/27/67

User: LOAD IMSOL
TSS $RPEAT LOAD CMND WITH REEL NUMBER

User: LOAD IMSOL 1920

TSS: $WAIT

TSS: $ NO LOAD DRUMS, FULL

User: !DRUMS
TSS: 15674WDS AVBL

User: !DIAL 9 I NEED 47K DRUMS PLEASE

TSS: $MSG IN.

TSS: FROM Ø9 JUST A MINUTE PLS.

TSS: FROM Ø9 LOAD NOW

User: LOAD IMSOL

TSS: $LOAD XX

User: GO

TSS: $MSG IN.