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ABSTRACT

The contents of this document, concerning the demonstration of a linkage between monetary incentives and academic achievement motivation and the utilization of this knowledge in educational programs, are organized in three sections. The first section is a report of an experimental demonstration of "the effect of monetary incentives on test performance of a sample of pupils in four Detroit public schools." The second section, "The effect of a self instructional-contingency managed mathematics program on student test performance," reports a study the purpose of which was to determine the effect of the SIMPLE (Self-Instructional Mathematics Program, Learn and Earn) program on the performance of students on a standardized achievement test. The third section, "Contingency managed self instruction self instructional reading laboratory," describes another application of the linkage between motivation and monetary incentives. The Self Instructional Reading Laboratory consists of the following key features: individualization, self instruction, self management, high motivation, differentiated staffing, and class size reduction. (JM)

[THE EFFECT OF CONTINGENCY MANAGED SELF-INSTRUCTION IN THE DETROIT PUBLIC SCHOOLS.]

THE EFFECT OF MONETARY INCENTIVES ON TEST PERFORMANCE OF A SAMPLE OF PUPILS IN FOUR DETROIT PUBLIC SCHOOLS

by Sheldon Sofer

Peter Manos

Judgments concerning the effectiveness of various instructional procedures rest heavily upon the scores students achieve on tests. Federal and state legislation relating to schools, public opinion and community support of local schools are greatly influenced by pupil test scores. Pupil performance on standardized tests is usually the basis for payment in performance contracts.

Valid assessments of educational programs cannot be made by test results alone. Nevertheless, the increasing use of standardized tests to help judge the effectiveness of various educational procedures represents a desirable attempt to use objectivity in assessing educational efforts rather than relying solely upon subjective data and/or outcomes that are difficult to quantify.

In light of all the imagination, effort and money being expended to raise pupils' performance level a key question is, "To what extent do results of standardized tests reflect maximum pupil performance?"

In order to answer this it is necessary to provide some type of additional motivation to the test taking situation itself while the instructional programs in which the students are participating are held constant. The following experiment was conducted during February, 1972, to investigate the test performance of pupils who were provided with monetary incentives.

Seven classes of grade 5 pupils from four Detroit Public Schools were selected to participate. The combined pupil population was representative of Detroit pupils in academic achievement, race and socio-economic status (see Table 1). These classes were randomly assigned to be part of the experimental or control groups.

Table 1

Racial Composition, Title I Classification, and Achievement Test Score Means of Four Schools Participating in Monetary Incentive Experiment

School	Title I Classification	Percent Racial Composition		Grade 4 ITBS Subtest Means	
		Black	White	Reading	Arithmetic
I	Non Title I	2.4	97.2	4.2	3.9
II	Non Title I	8.8	87.4	3.8	3.9
III	Non Title I	75.3	23.5	3.4	3.5
IV	Priority A	79.6	18.0	3.0	3.4
Mean		52.3	45.8	3.4	3.6
City Mean		63.8	34.8	3.2	3.5

Schools I, II and III are located in middle income areas of Detroit. The Priority A classification of School IV, which is in Detroit's Model Cities area, indicates that at least 55% of the pupils come from low income families as determined by the 1960 census.

PROCEDURE

The Paragraph Meaning and Arithmetic Computation subtests of the Intermediate I level of the Stanford Achievement Test (SAT) were administered to both groups during their homeroom periods by the homeroom teacher. In the two schools having both an experimental and control group, the control group was the first to be tested. The instructions given to the pupils were in strict accordance with the test publisher's manual of directions. In addition, the following agreement was read to the pupils in the experimental group:

> *Before you take these tests, I am going to read an agreement between us. There are 39 questions on the arithmetic test. You will be given a nickel for each correct answer you get. You could earn $1.95 for the arithmetic test. There are 60 problems on the reading test. You will be given a nickel for each correct answer you get. You could earn $3.00 for the reading test. You could earn $4.95 for both the reading and arithmetic tests. We will grade your tests and pay you within about one week. Remember, you will earn a nickel for each correct answer you get on the arithmetic and reading test. Good luck. Do the best you can.*

Approximately 170 pupils were tested. Only the test results of pupils were used for whom grade 4 Iowa Test of Basic Skills (ITBS) scores were available. In order to make the control and experimental groups at each school of equal size, pupil scores were randomly dropped from whichever group was larger. The final number of pupils whose test results were analyzed was 134.

Analysis of covariance was used to analyze performance of the experimental and control groups on the two subtests. In the area of reading, the pupil's Reading subtest score from his or her grade 4 ITBS was used as the independent variable and the score on the Paragraph Meaning subtest was the dependent variable. Similarly, for arithmetic the ITBS Arithmetic Total subtest score was the independent variable and the Arithmetic Computation subtest score was the dependent variable.

RESULTS

On both the Paragraph Meaning and Arithmetic Computation subtests, the differences in performances between the experimental and control groups were significant at the .01 confidence level (see Table 2).

Table 2

Iowa Test of Basic Skills and Stanford Achievement Test Scores* of Experimental and Control Groups

	N	ITBS Reading		SAT Paragraph Meaning	
		Mean	S.D.	Mean	S.D.
Control	67	31.9	8.8	39.7	11.1
Experimental	67	35.0	11.3	45.4	16.1
		ITBS Arithmetic Total		SAT Arithmetic Total	
		Mean	S.D.	Mean	S.D.
Control	63	36.2	6.3	38.2	7.6
Experimental	63	35.9	7.4	40.4	7.8

*Expressed in grade score units.

A similar analysis was made on a school by school basis. Since School I had only an experimental group and School II only a control group, they were treated as a single unit. Tables 3 and 4 show means and standard deviations of the test results for each of the three control-experimental groups in the areas of reading and arithmetic. On the Arithmetic Computation subtest, the difference in performance between the control and experimental groups was significant at the .05 confidence level for School IV and Schools I and II. There was no significant difference in the performance of the groups at School III. The difference in performance between the control and experimental groups in School IV on the Paragraph Meaning subtest was significant at the .01 confidence level. The differences in performance on the Paragraph Meaning subtest between the groups at other schools were not significant.

Table 3

Iowa Test of Basic Skills Reading and Stanford Achievement Test

Paragraph Meaning Scores* of Experimental and Control Groups in Individual Schools

	N	ITBS Reading		SAT Paragraph Meaning	
		Mean	S.D.	Mean	S.D.
SCHOOLS I-II:					
Control	23	32.6	8.0	45.3	8.5
Experimental	23	43.2	10.6	59.7	15.0
SCHOOL III:					
Control	27	35.1	9.7	39.9	12.0
Experimental	27	30.2	7.7	34.1	9.5
SCHOOL IV:					
Control	17	26.1	4.9	31.7	8.2
Experimental	17	32.3	11.2	43.9	9.7

*Expressed in grade score units

Table 4

Iowa Test of Basic Skills Arithmetic Total and Stanford Achievement Test

Arithmetic Computation Scores* of Experimental and Control Groups in Individual Schools

	N	ITBS Arithmetic Total		SAT Arithmetic Computation	
		Mean	S.D.	Mean	S.D.
SCHOOLS I-II:					
Control	20	35.5	5.9	36.0	9.0
Experimental	20	40.9	5.4	45.5	8.0
SCHOOL III:					
Control	27	38.1	7.6	39.4	7.4
Experimental	27	32.8	6.8	35.1	6.2
SCHOOL IV:					
Control	16	34.1	3.1	38.8	5.9
Experimental	16	34.8	7.8	43.0	5.3

*Expressed in grade score units

DISCUSSION

This experiment shows that monetary incentives can improve the performance of some pupils on standardized tests. Of particular interest is the fact that the most significant improvements were made in reading by pupils attending school in a low income area. The lack of motivation on the part of these pupils during test taking situations may be precluding a valid assessment of how well they can perform. The accusation that compensatory education programs for pupils from low income families have not been productive may be in error. If pupils are not adequately motivated during the test taking situation, we cannot really know how effective our programs have been.

There are many compensatory education programs now operating within the system the refunding of which depends upon pupil performance on standardized tests. Even though the objectives of these programs are not limited to improving pupil performance on standardized tests, it is essential that all reasonable steps be taken to improve such performance. The instruments used to measure the degree of pupil competency in academic areas are usually the most valid and reliable instruments available. Therefore, any information relating to the amount of discrepancy that exists between pupil potential and actual performance on standardized tests would be helpful in planning and carrying out compensatory education programs. Further investigation should be conducted in order to obtain answers to the following questions:

Will larger monetary incentives produce greater test scores?

What other types of incentives will produce equivalent or greater gains?

What will be the effect upon pupils not receiving monetary or other special incentives?

Once these questions have been answered, educators will be in a better position to eliminate discrepancies between pupil potential and actual performance.

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THE EFFECT OF A SELF INSTRUCTIONAL - CONTINGENCY MANAGED MATHEMATICS PROGRAM ON STUDENT TEST PERFORMANCE

An Interim Report

by Joseph Hirsch
Richard Macon
Sheldon Sofer

A program entitled "Self-Instructional Mathematics Program, Learn and Earn" (S.I.M.P.L.E.) was developed for students in grades 4 and above who have not mastered basic arithmetic computation skills. The program contains small sequential steps, systematic review and an incentive system.

The purpose of this study was to determine the effect of the SIMPLE program on the performance of students on a standardized achievement test.

PROCEDURES

During September 1971, the Arithmetic Computation Sub-test of the Stanford Achievement Test, Intermediate I, was administered to all students in a Middle School in Detroit. This school is a Priority A, Title I school which indicates that at least 55% of the pupils come from low income families as determined by the 1960 census. From a list of students who scored two years or more below grade level, 108 were selected randomly to receive their mathematics instruction in whole number basic

skills exclusively in the SIMPLE program. The remaining students comprised the control group.

Schedule

Six classes of 50 minutes duration were held daily. Each class had a capacity of 18 students and was managed by three teacher aides who were supervised by the school administration and the authors of the SIMPLE program.

Instructional Program

The following outline briefly describes the structure of the SIMPLE program.

1. Diagnosis

At the start of every skill area each student took a diagnostic test to determine his efficiency with the skills taught in that area. For diagnosis of basic fact skills students would take a specified sheet containing several exercises, punch in the starting time by inserting the exercise sheet in a date and time recorder, answer the questions in writing, and punch out again. More detailed diagnostics were delivered through the use of a tape-driven slide projector, which gave the student 5 seconds to answer each question. Algorithmic skills were diagnosed by directing students to solve problems provided on worksheets. These tests were not timed.

Students who passed a diagnostic test were given the diagnostic for the next skill area. This procedure continued until a student's diagnostic results indicated need for remediation in a specific skill area.

2. Prescription

Once a student did not pass a diagnostic he was given further tests designed to more specifically identify his weaknesses within a skill area.

Prescriptions for basic facts were provided through the use of audio - flashcards. These were 6" X 12" cards with a magnetic tape on the back which allowed a student to record and listen to himself as well as to statements previously recorded by the instructor to which he could listen but which he could not erase. Incomplete fact statements were printed on the cards. The students recorded the completed fact and then listened to the pre-recorded master track to check his answers.

Algorithmic prescriptions were presented in booklets accompanied by cassette tapes which were provided for students with reading problems. The booklets and tapes gave examples, explanations and practice of each of the steps in the algorithmic process being remediated.

3. Evaluation

Following each remediation, the student's performance on the skill was evaluated by use of the pulse - driven projectors, timed worksheets, or, by his reciting complete basic fact statements to the teacher aides. Following this evaluation a student would be branched either to a further prescription or to exercises designed to provide additional practice with the skill or to the next skill's diagnostic test.

4. Review

Drill and practice exercises were used throughout the program in the form of commercial kits or specially prepared worksheets designed to review skills previously learned, e.g., while a student was working on multiplication skills he would also be reviewing skills in addition and subtraction.

5. Incentives

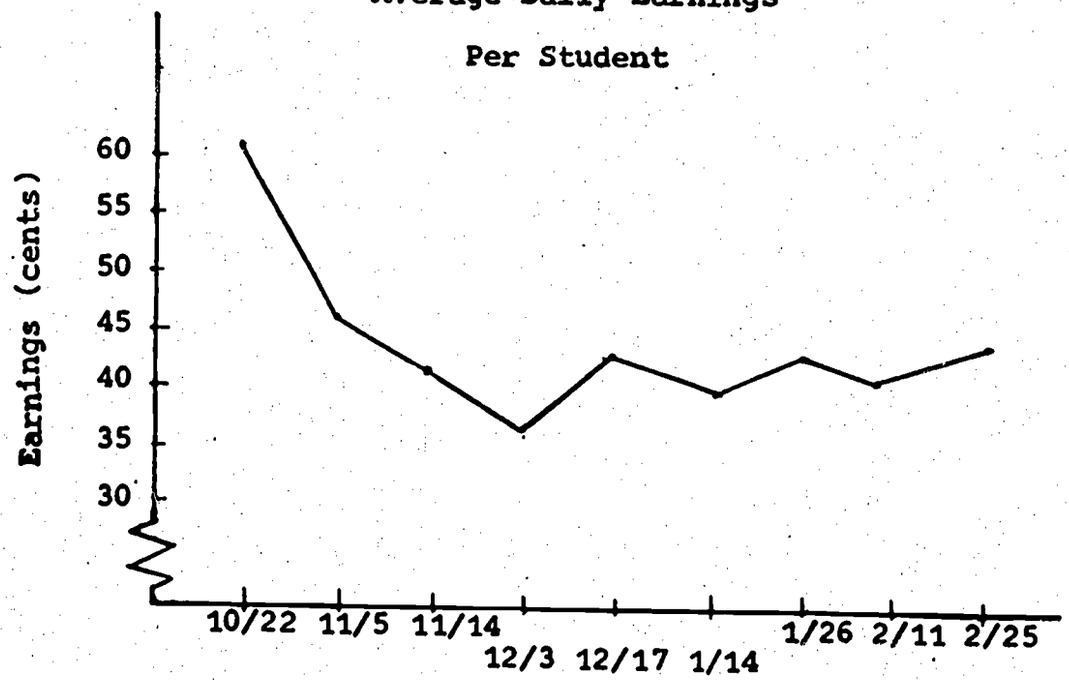
To check his work, a student would activate a desk-top computer by inserting a previously programmed magnetic card and then entering his answers by typing on the computer's keyboard. The computer output would inform the student as to how many answers were correct, which answers were incorrect, and also whether 85% proficiency had been achieved on the test. He would then present the output tape to the teacher aide who would award a token if the student had met the 85% proficiency criterion. At the end of each class period the students turned in their tokens after the number they earned had been recorded. Students could earn tokens for their successful performance of diagnostic, prescriptive and review activities. Each token was worth $0.20 and the students received a paycheck once every two weeks for the amount of money which they had earned.

The study of the average daily earnings of students by pay periods revealed a range of $0.36 to $0.61 per pupil per day. Table 1 shows that although the initial rates were high, there was a leveling off at about $0.44 per day. The initially high

TABLE 1

Average Daily Earnings

Per Student



rate is the result of the fact that at the beginning of the program students were given tokens not only for meeting the 85% proficiency criterion but also for demonstrating correct self-management behaviors.

6. Self-Management

All materials needed by a student were stored in numbered envelopes. Early in the program, students learned how to find supplies for their next activity and how to operate all of the hardware equipment, i.e., audio-flashcard machines, cassette tape recorders, slide projectors and desk-top computers.

7. Individualization

Each student progressed through the program at his own rate. In order to keep track of each student's progress he had a Student Record Booklet in which all of his activities and performance were recorded. Entries into this booklet were determined from a data management listing which contained the entire instructional strategy for SIMPLE i.e., diagnostic tests, prescriptions and branching activities.

Testing

The pretest was given to both the Control and SIMPLE group in September 1971. The posttest was given in February 1972. The tests were given to the students in their regularly scheduled classes under uniform conditions. Only those students who took both the pretest and the posttest were included in this report.

RESULTS

Table 2 presents the pretest and posttest scores and mean gains for both the Control and SIMPLE groups. Within the five month period of the tests it can be seen that the Control group made a gain of four months while the SIMPLE group made a gain of eight months. A two-tailed t-test on the grade equivalency gain scores indicated that the mean gains were significant beyond the 0.01 level.

TABLE 2

Stanford Achievement Test Grade Equivalency Scores and Gains for Experimental and Control Groups

Group	Pretest		Posttest		Gain	t
	Mean	S.D.	Mean	S.D.	Mean	
Control (N = 75)	4.0	0.6	4.4	0.8	0.4	2.97*
SIMPLE (N = 78)	4.0	0.7	4.8	1.1	0.8	

*Significant beyond the 0.01 level.

Since the main thrust of the SIMPLE program was to raise the level of performance of basic arithmetic computations of those students who were two or more years below grade level the relative frequency of the gains of the SIMPLE and Control group is compared (see Table 3). In the control group 15% of the students gained more than one year as compared to 28.5% of the students in the SIMPLE group. A chi-square test showed that the difference between the distributions of the SIMPLE group compared to the Control group was significant beyong the 0.01 level.

TABLE 3

Comparison of Grade Equivalency Distributions

Between SIMPLE and Control Students

Group		Grade Equivalency Gain in Months						ROW TOTAL
		0 or less	1-4	5-8	9-12	13-16	17 or more	
Control (N = 75)	frequency	21	22	12	9	9	2	75
	(percent)	(28)	(29)	(16)	(12)	(12)	(3)	(100)
SIMPLE (N = 78)	frequency	15	15	14	12	5	17	78
	(percent)	(19)	(19)	(18)	(15.5)	(6.5)	(22)	(100)

chi-square value = 15.83 df = 5

significant beyond 0.01 level

In order to speak of "learning rate" in terms of these test results, the following definitions must be taken into account:

a) "Learning rate" is the grade level gain (in months) per month elapsed since entry into the program.

b) Assumed grade equivalence for beginning first graders is 1.0.

c) The learning (school) year is 10 months.

d) Beginning seventh graders have spent 60 months in school.

Using the above definitions, the average learning rate for the SIMPLE and Control students at the start of the experiement was $\frac{39-10}{60} \approx$ 0.5 months per month.

TABLE 4

A Comparison of Learning Rates Between SIMPLE and Control Students

Group	Elapsed Time	
	9/65 - 9/71	9/71 - 2/72
Control	0.5 month/month	0.88 month/month
SIMPLE	0.5 month/month	1.80 month/month

Table 4 shows the changes in learning rates that occurred between September 1971 and February 1972 for each of the groups. The learning rates of students in the Control group increased by a factor of 1.7 compared to an increase by a factor of 3.6 for the SIMPLE students.

DISCUSSION

Although this report is an interim evaluation there are indications that SIMPLE may be an effective remedial program. The SIMPLE students made twice the gain of the Control students. Of the SIMPLE students, 28.5% gained more than a year as compared to 15% of the Control group.

Despite these comparisons it is clear that more conclusive decisions regarding the effectiveness of SIMPLE cannot be made until its effects are studied over a longer period of time and, until it is compared to other experimental programs in order to make adjustments for the Hawthorne effect inherent in any new program.

The notion that difference in pupil performance is related to quality of textbook materials or to the availability of other complementary teaching aids may be in error. This study suggests that high motivation and individualization of method appear to be much more critical to pupil success. Further inquiry could provide answers for the following questions:

1. What are the comparative effects of:
   a. monetary incentives without individualization
   b. individualization without monetary incentives?
2. What is the amount of monetary incentive required to produce maximum achievement?
3. What incentives can produce the same effects as monetary incentives?
4. What incentive schedules (changes in amount and kind) produce the maximum effect upon achievement?
5. What, if any, behavioral changes occur when a student moves from a highly motivated program into a traditionally operated classroom?

The results of this study indicate that continuation and further evaluation of the SIMPLE program are warranted.

CONTINGENCY MANAGED SELF INSTRUCTION

SELF INSTRUCTIONAL READING LABORATORY

The Self Instructional Reading Laboratory (SIRL) consists of the following key features:

Individualization
Self Instruction
Self Management
High Motivation
Differentiated Staffing
Class Size Reduction

Each SIRL in an elementary school is designed to handle approximately 100 students each day, i.e., 6 groups of 16 students. Each group is scheduled for one hour in the laboratory. In the junior high schools, the day is divided into three two-hour class periods with each SIRL accomodating approximately 16 students per period.

INDIVIDUALIZATION: The SIRL system is designed to accomodate two key differences in the way in which individuals learn. One is rate and the other is the amount of material to be mastered at any one time. The branching SIRL program allows each student to work at his own rate and breaks the steps down into different size units. In any given class, there may be a range of students from those who are just learning to read to those who are reading over 3,000 words. Lesson sizes vary from one or two new words to 48 new words. In order to provide a careful method for keeping track of each student's progress, the SIRL staff has developed data-management booklets. Each student has one of these. The booklet provides a method for recording the student's progress and also a method for indicating to the teacher aide and/or the student what sequence of activities the student is to perform. This takes into account the need for different system branches for different students, depending upon their particular learning needs.

SELF INSTRUCTION: Before the students are taught to read, they are taught the skills necessary in order to teach themselves. Perhaps the most important of these is attending behavior. The student must learn to focus his attention on the task before him. He must be able to concentrate in order to acquire any new skill. The student must also be taught the correct practice techniques. If a word is being spelled, for example, then his eyes must focus upon each letter as it is said. As a part of his practice techniques he must learn to repeat his tasks until he has acquired the level of proficiency required. Once the student has acquired these self instructional techniques, he applies them to teaching himself reading. If a student makes an error while being tested, this fact is indicated, but he must teach himself the correct responses. The SIRL program is designed in such small steps that it allows the student to make the generalizations necessary to teach himself to read.

SELF MANAGEMENT: The students are taught to work with little, if any, adult instructions. They learn to take their seats and begin working on their own initiative. They are responsible for returning the materials in their lesson to the proper place and for obtaining their new lessons. They learn to operate all the equipment in the room. This includes an audio-flashcard reader, a cassette tape player, accompanying headsets and other equipment which is found in the play area. As the students progress through the SIRL program, they take on increasing responsibility for the management of their own activities.

HIGH MOTIVATION: As soon as a student believes that he has mastered a lesson, he raises his hand and is checked by a teacher aide. Every time he passes a test during the forty minute work period, he is given a token. At the end of the work session, the elementary school students are allowed to use their tokens to "rent" time playing with toys in another part of the room. The toys which are the most popular are those which allow the student to make something which he can take home. In order to keep the play area motivating, new toys are periodically introduced and old toys are taken off the market. Although the play area is intended primarily for entertainment, it also has instructional value. It helps the socialization process by providing opportunities for students to play together. Young students often play alone while other students play nearby but they soon learn to play with each other in the SIRL. Educational toys are used which help develop coordination, spatial relationships, and additional reading practice. The students also learn to save their tokens since toys are priced differently and they may not have enough tokens to play with a particular toy. The students play an active role in deciding what toys should be included in the play area. In the junior high school SIRLs, the students are also given tokens. Each token is worth five cents. At the end of each two week period, the student is given a paycheck representing the cash value of all the tokens he has earned.

DIFFERENTIATED STAFFING: The SIRL is managed by teacher aides. One professional teacher is required, as a supervisor, for between five and ten laboratories or from between 500 to 1,000 students depending upon the proximity of the SIRLs. The laboratory provides an opportunity for a maximum utilization of paraprofessionals. The teacher aides keep track of student performance in the students' data management booklets, set out the equipment and the first lesson for the day, manage the play area, and, more important, they check the students. The data management booklet indicates the test each student is to be given. The initial tests are all oral reading. The aide listens to the student and points out any errors which the student has made. It is then the student's responsibility to practice his lesson again and to correct any errors. The professional teacher is responsible for seeing to it that the aides function properly, for identifying special speech, sight and/or hearing problems, and for seeing to it that students with these problems receive special services available to them. He or she is responsible for training the aides initially and for training any new aides which are hired.

CLASS SIZE REDUCTION: During the regular school day, one elementary school SIRL serves approximately 100 students. Sixteen students spend 50 minutes each day in the laboratory. Assuming that a teacher has 32 students, for two hours a day she would deal with only 16 since half would attend the SIRL one period and the other half another period. This provides the teacher with the opportunity to group her students as she wishes. The SIRL staff recommends that the regular classroom teachers take advantage of this class size reduction to provide the remaining students with further practice in the skills being presented in the laboratory. In this way the students may have the advantage of the necessary individualization as well as the group dynamics.

The following list represents the 25 Detroit Public Schools which will have SIRLs operating during the 1971-1972 school year.

ELEMENTARY	JUNIOR HIGH
Breitmeyer	Barbour
Chandler	Butzel
Chaney	Durfee
Dwyer	Hutchins
Franklin	Joy
Hillger	Pelham
Joyce	Sherrard
Kennedy	Spain
Marcy	
Maybee	
Monteith	
Moore	
Nichols	
Owen	
Palmer	
Pingree	
Scripps Annex	

Principals, teachers and region staff from these schools attended a presentation of the SIRL. They were given the option of having a SIRL installed in their school. They were free to reject the program. All principals chose to participate, some asking for additional SIRLs. The program will serve students in the early elementary, upper elementary and junior high school grades. Approximately 2,300 students will participate in the SIRL program. The initial management will be implemented by placing four teacher aides in each SIRL. Each supervisor will be responsible for making sure that each aide is performing her tasks correctly. They will also be responsible for making certain that the SIRL system is working properly and for pointing out any deficiencies to the SIRL director.

If additional information is desired, please contact:

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