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A Comparison of Two Systems of Instruction in Three Sixth-Grade Language Classes

David G. Fossum
Western Michigan University

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A COMPARISON OF TWO SYSTEMS OF INSTRUCTION IN
THREE SIXTH-GRADE LANGUAGE CLASSES

by

David G. Fossum

A Project Report
Submitted to the
Faculty of The Graduate College
in partial fulfillment
of the
Specialist in Education Degree

Western Michigan University
Kalamazoo, Michigan
December 1977
ACKNOWLEDGEMENTS

The successful completion of this project represents an epic feat for this writer. As all epics, this one depended on the invaluable efforts of a cast of highly supportive characters. Matt Hanichen provided his classroom and cooperation in carrying out the study. Ann Kocer helped to develop materials and procedures and carry them out in the classroom. Several professors have provided models, inspiration and instruction that served as antecedents for my responses (I anxiously await consequation). As advisor and friend Dr. Howard Farris has provided both professional and personal support in addition to a wide variety of broadening experiences in a range of settings. Drs. Galen Alessi and Brian Iwata served as committee members for this project, but more importantly each provided a dynamic model to emulate in working in the field of education. Dr. Jack Michael also provided much of the food that fed my thoughts ("been eating much, Dave?"). Jane Howard expended "blood, sweat, toil and tears" in the preparation, editing, and revising of the manuscript (but it may have been out of guilt for finishing first). Finally, my parents have sponsored this epic along with all my other comedies and tragedies. Grateful thanks are offered to all the above for their help and support.

David G. Fossum
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IN THREE SIXTH-GRADE LANGUAGE CLASSES.

Western Michigan University,
Ed.S., 1977
Education, psychology
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Individualization of instruction is a widespread goal of education, and difficulty in achieving it is a common complaint among educators at all levels of instruction. Michael (1969, 1974) has presented elegant behavioral analyses of the basic functions served by a teacher and identified many of the main sources of difficulty encountered in attempts at group instruction. A brief summary of the main functions of a teacher according to Michael follows:

1. To present a sequence of tasks or program of instruction appropos for the student,
2. To provide differential consequation for correct and incorrect responding, and,
3. To provide some form of differential consequation for performing the instructional tasks rather than other activities.

In tutorial or "one-to-one settings, instruction is usually quite effective since the above functions can be fairly easily carried out by the instructor on a personal basis without much preparation or materials development. The natural contingencies of the situation will bring the instructor in contact with the strengths and deficiencies of both the student and the program of instruction. Immediate adjustments in the size, pacing, sequence and difficulty of tasks can be made spontaneously and personally by the instructor. As long as the instructor can specify objectives and criteria to be reached and provide differential consequation for correct and
incorrect responding, instruction should be effective. However, the task of presenting an appropriate sequence of objectives, monitoring of responding, and providing differential consequation for correct and incorrect responding for a large group of students requires considerable development and preparation of materials and procedures.

A number of techniques have been designed to alleviate the difficulties encountered in teaching groups of students. Among these are the Personalized System of Instruction (PSI) sometimes referred to as the Keller system (Keller, 1968), self-management procedures (e.g., Glynn & Thomas, 1974), contingency management (e.g., Malott & Svinicki, 1969), and contracting (e.g., Farris, 1975). When considering these various techniques in terms of Michael's analysis, it appears that the Keller system is perhaps the most explicit and direct in specifying procedures that would help a teacher perform these functions. Similarly, the potential value of self-management techniques, while not defined as a system of instruction per se, becomes apparent by making it possible to shift at least part of the burden of monitoring and consequating student responses from the teacher to the students themselves. Thus, self-management techniques could function in a manner complementary to the Keller System by making it more likely that systematic
differential consequation for academic behavior will occur.¹

First, consider the Personalized System of Instruction. Keller (1968) characterized the five main distinctive features of PSI as:

1. students self-pace their assignment completion,
2. students must meet a mastery criterion for each unit before advancing to the next unit,
3. lectures are used for motivation rather than primary source of information,
4. stress is on written work in teacher-student communication, and,
5. use of proctors permits repeated testing and quick scoring of student repertoire.

In the past ten years considerable research has been reported concerning the value, design, and applications of PSI in college courses (e.g., Johnston, 1975). For example, McMichael and Corey (1969) and Meyers (1970) were concerned with broadening the subject matters to which PSI was applied. The former study involved teaching a general psychology course and the latter a statistics class. Both studies showed favorable student ratings of PSI. McMichael and

¹Contingency management as reported by Malott & Svinicki (1969) and contracting as described by Farris (1975), DeRisi & Butz (1975), and Homme, Csanyi, Gonzales, & Rechs (1970) are somewhat less explicitly defined as systems of instruction and therefore are more difficult to evaluate in terms of Michael's criteria. These approaches have been used to individualize, however. They generally involve breaking assigned work into small, clearly specified segments and specifying for the student in advance the conditions and consequences for performing each segment of work. It should be noted that various components of contracting and/or contingency management may be identified in both the Keller system and self-control procedures.
Corey also demonstrated final exam performance of PSI students to be superior to that of students in a traditional lecture format. Other studies have considered the cost effectiveness of PSI (Born & Davis, 1974), the extent to which performance criteria for grades affect student performance in PSI classes (Johnston & O'Neill, 1973), and pre-post test gains showed by PSI students (Alba & Pennypacker, 1972).

More detailed analyses of the use of PSI have been conducted. Among issues examined have been: the retention of learning in PSI courses, the number and kind of students affected by PSI courses, and the level of skills possible to teach in PSI courses. Again in college-level courses, McMichael and Corey (1969) and Cooper and Greiner (1971) demonstrated that retention was superior in PSI courses compared to traditional lecture courses.

Wood and Wylie (1975), Morris and Kimbrell (1972) and Born, Gledhill, and Davis (1972) raised the issue of whether certain kinds or classes of students were differentially affected by PSI. In general these studies have reported that poor students profit the least from PSI, average students profit the most and good students do well in PSI courses just as they do in other types of courses. A third issue raised has been the level of skills taught in most PSI courses (Miller & Weaver, 1976). Miller and Weaver demonstrated that "concept programming" in a PSI course could successfully teach correct generalization of abstract concepts to novel situations.

All the studies above, and the vast majority of those reporting
on PSI courses in the literature give favorable results but are restricted to college-level courses. In considering techniques to individualize at the early levels of instruction it is interesting to note that "contingency management" systems are more typically reported than other techniques for individualizing. However, it would seem that of the four general techniques for individualizing (PSI, self-management, contingency management, and contracting), the Keller system may be the most beneficial at early levels of instruction due to its explicit emphasis on self-pacing and remediation.

At early levels of instruction, students spend all day in class and complete virtually all their study and learning activities in class. When elementary students finish assignments early in class, problems often arise in scheduling activities in class to occupy them productively and/or divert them from counter-productive activities while slower students work on the assignments. On the other hand, slower students may be forced to abandon material that they have not learned because the majority of students in the class are ready to master new instructional material. In later levels of instruction, students perform most of their work outside of class and therefore finishing assignments quickly or slowly only affects the amount of time the student can spend in other activities. The in-class activities typically are scheduled by the teacher independently of the student's rate of work completion or mastery. For these reasons, the scheduling and pacing of class activities may be more crucial at the elementary levels.
Questions then arise as to why the Keller system has not characteristically been attempted at elementary levels of instruction. An analysis suggests two possibilities: first, effective functioning in a PSI system requires that a student must have some self-management skills in order to derive benefits from its self-paced characteristics. Elementary school students probably have a less sophisticated repertoire in self-management than college students. Second, elementary school teachers are not typically in a position to make use of proctors (students who have already mastered the material) which is critical to the functioning of the Keller system (as previously described).

While not much can be done about expanding the staff resources of the typical elementary school teacher it does seem reasonable to attempt to teach some basic self-management skills to elementary school students to increase the probability of their succeeding in a Keller-style course while simultaneously fulfilling some of the prompting, monitoring, and consequating functions performed by proctors in PSI courses. A review of the literature shows that self-management or self-control techniques, independent of any particular instructional system (e.g., PSI), have been reported as a second method related to improving the instruction of groups.

A number of studies with earlier level students have shown that performance improves when students control the contingencies related to completing academic activities. For example, Lovitt and Curtiss (1969) showed that an elementary student's work rate...
rose when he, rather than the teacher, assigned point values to various assignments. Broden, Hall, and Mitts (1971) showed that the behavior of two eighth-grade students improved as a function of their self-recording of behavior. Glynn and Thomas (1974) also showed self-assessment and recording to be effective in increasing on-task behavior for nine students in a classroom. Even the behavior of first graders has been affected by self-control techniques. Fink and Carnine (1975) reported that first grade students made fewer arithmetic errors when they graphed their own error frequencies. On the other hand, the effectiveness of self-control techniques is not uniform. Bristol and Sloane (1974) found that self-recording did not seem to increase the test scores of college freshmen. Santogrossi, O'Leary, Romanczyk, and Kaufman (1973) found that students' disruptive behavior occurred at higher rates when control of the reinforcement contingencies for this behavior was given to them.

While there has been some variability in findings concerning the effectiveness of procedures designed to teach self-control, it appears that they are promising techniques in helping students to learn to function effectively in situations somewhat independent of teacher-controlled contingencies.

According to Glynn, Thomas, and Shee (1973) self-control procedures can include any or all of the following components:

1. **self-assessment**: The individual may examine his/her own behavior and decide whether or not he/she has performed a specific behavior or class of behavior,
(2) **self-recording:** The individual may objectively record the frequency of his/her performance of a given behavior or class of behaviors,

(3) **self-determination of reinforcement:** The individual may determine the nature and amount of reinforcement he/she should receive contingent upon his/her performance of a given behavior,

(4) **self-administration of reinforcement:** The individual dispenses his/her own reinforcement (which may or may not be self-determined) contingent upon his/her performance of a given behavior or class of behaviors.

Of the self-control procedures considered above, self-recording appears to be the logical first step in a program to teach self-management to elementary school students as it is probably the simplest to teach in that it requires minimal discriminations on the part of the student.

The task, then, in developing a Keller or individualized system at the elementary school level appears to be to combine components of both the Keller system and self-control procedures in order to remedy deficiencies that may exist in the repertoire of the elementary school student or limitations in staff resources. Homme (1970), in a chapter titled, "Shifting to Self-contracting" seems to suggest the feasibility of such an approach. In this chapter Homme recommends that contracts regarding academic performance gradually shift the control of the terms of the contract from the teacher to the student.

For further details necessary for the adaptation of an individualized system of instruction to early education levels, it is useful to return to Michael's analyses (1969, 1974) of effective instruction. In addition to the necessity for clearly specified
objectives and materials to teach them, Michael lists several practices that may make instruction of groups more effective:

1. Build consequation for correctness into learning activities (i.e., make activities self-correcting),
2. Frequently test to sample student repertoires and assure proper use of materials,
3. Use remediation as a consequence, and
4. Improve the consequences which maintain participation in the academic activities - perhaps by contracting.²

The first step in adapting PSI to early-ed levels, then, involves writing specific, behavioral objectives appropriate for the topic and population to be taught. Next would be the development of self-correcting activities and exercises to teach these objectives. In order to assure that students did not repeat known material or abandon unknown material, pretests and a set of alternative post-tests for each objective would have to be written to allow frequent and, if necessary, repeated testing. Development of a contract system would permit presentation of course activities and corresponding incentives in such a way that students could understand and participate in the system independently.³

²All of these practices are incorporated in PSI systems.
³See Vargas (1972) for a description of how to write behavioral objectives and develop them into units of instruction. Waynant and Wilson (1974) have provided suggestions for the construction of self-correcting learning activities. Finally, Homme, et al, (1970) and DeRisi and Butz (1975) are good references for writing behavioral contracts.
Finally, a component of self-management procedures such as self-recording should be in effect such that students would be more likely to succeed in such an individualized, self-paced system while simultaneously relieving the teacher of some of the burden of being responsible for prompting and consequating all relevant student behavior.

The present study was an attempt to synthesize just such a system of instruction at the sixth-grade level. The main aims of the study were: (1) to determine whether a Keller-like system of instruction could be adapted to function with one teacher in two sections of a sixth-grade language arts class without additional staff resources such as proctors, (2) to compare the performance of sixth-grade students under the adapted PSI format and the more traditional classroom group format, (3) to use self-recording as a technique to increase the probability of these students succeeding in a Keller-style course, and (4) to determine whether annual standardized achievement tests would reflect the performances of students in such a system.
METHOD

Subjects

The subjects for this study were 63 sixth grade Language Arts students from the ages of 11 to 13 years at the beginning of the study. They were from three pre-existing sections of the sixth grade, designated for experimental purposes 6A, 6B, and 6C. There were 14 girls and 7 boys in 6A, ten boys and ten girls in 6B, and 11 girls and 11 boys in 6C, totalling 35 girls and 28 boys. When the study began the classes had been meeting for 52 minutes per day, five days per week for approximately ten weeks.

Setting

The study took place in the Middle School of a small, rural community near Kalamazoo, Michigan. The Middle School included grades five through eight with a total enrollment of approximately 300. There were 12 regular education classrooms in two wings. The sixth graders remained in one wing of six classrooms and changed classes once every 55 minutes with seven academic periods during every day and a 30 minute lunch period. The study was conducted in one of the sixth grade classrooms during the fourth, sixth, and seventh periods which were attended by sections 6A, 6C, and 6B respectively.

The classroom was traditionally arranged with the teacher's desk at the front of the room and the student's desks facing the
teacher's in five rows of six desks each. The left wall and the front wall contained a chalkboard and a bulletin board across their entire widths. The right wall had two windows and a bank of ventilators. The rear wall was used to hang charts and posters.

Procedure

The study was conducted from November, 1975 until May, 1976, with the three sections of the sixth grade Language Arts classes. The sections were all taught by the same teacher using identical textbooks and instructional objectives.

Instruction was divided into nine units based on textbook chapters. The dates and titles of the units are shown in Table I. The units were designed to be two to three weeks in duration, and all three sections started each of the units at the same time.

Two instructional systems were utilized during the course of the study. Only sections 6A and 6B were exposed to both systems. The first system of instruction was referred to as the Group System (GS) and the second as the Individualized System (IS). All three Language Arts sections were conducted under the GS for instructional units I through III. Beginning with unit IV, students in 6A were changed to the IS (and continued under this system through unit IX); while sections 6B and 6C maintained under the GS. The 6B language arts section was switched to the IS beginning with unit VII. Students in 6C were never exposed to the IS but only the GS during all nine instructional units. (See Table II.)

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### TABLE I

**NUMBERS, DATES, AND TITLES OF INSTRUCTIONAL UNITS**

<table>
<thead>
<tr>
<th>Unit Number</th>
<th>Dates</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>11/24/75-12/5/75</td>
<td>Homonyms, Homographs, and Synonyms</td>
</tr>
<tr>
<td>II</td>
<td>12/8/75-1/20/76</td>
<td>Letter Writing</td>
</tr>
<tr>
<td>III</td>
<td>1/21/76-1/30/76</td>
<td>Review of Units I and II</td>
</tr>
<tr>
<td>IV</td>
<td>2/2/76-2/26/76</td>
<td>Nouns</td>
</tr>
<tr>
<td>V</td>
<td>3/1/76-3/26/76</td>
<td>Pronouns</td>
</tr>
<tr>
<td>VI</td>
<td>3/29/76</td>
<td>Review of Units IV and V</td>
</tr>
<tr>
<td>VII</td>
<td>3/30/76-4/16/76</td>
<td>Verbs</td>
</tr>
<tr>
<td>VIII</td>
<td>4/26/76-5/14/76</td>
<td>Capitalization and Punctuation</td>
</tr>
<tr>
<td>IX</td>
<td>5/17/76-5/21/76</td>
<td>Review of Units VII and VIII</td>
</tr>
</tbody>
</table>

The GS consisted of essentially the same procedure and activities that the teacher used before the study began (although for the purposes of this study, unit pretests and assignment sheets were added to this instructional package). It was called Group Instruction since all the students in the classroom were generally supposed to participate in the same activity at the same time. The IS was an attempt to allow each student to work at an independent rate. It also was intended to let students avoid repeating class activities related to skills already mastered by offering a variety of alternatives. At the same time it was designed to encourage every
<table>
<thead>
<tr>
<th>GROUP SYSTEM</th>
<th>INDIVIDUALIZED SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>6A Unit</td>
<td>1 2 3</td>
</tr>
<tr>
<td>6B Unit</td>
<td>1 2 3</td>
</tr>
<tr>
<td>6C Unit</td>
<td>1 2 3</td>
</tr>
</tbody>
</table>

*SRA Achievement Test (Language Arts section only) administered between units 1 and 2. The entire battery of SRA Achievement Test was administered between units 7 and 8.
student to master two to four skills considered basic in each unit. These skills were designated as the unit's "minimal objectives".

The GS and the IS varied along five main dimensions: (1) assignment scheduling and recording, (2) pretests, (3) teacher activities, (4) evaluation and grading, and (5) review.

**Assignment scheduling and recording**

Both systems included the same Unit Assignment Sheet distributed at the beginning of each unit (see Table III). The sheet identified and listed the unit's minimal objectives first, followed by the remainder of the unit's objectives. Included in each objective was the criterion for mastery. Immediately following each objective were references to corresponding quizzes and exercises designed to teach and test that objective. Finally, the point value of each objective was listed. Also included on the Unit Assignment Sheet was the grade-point scale which was the same for each unit.

In the GS the number and order in which assignments were to be completed was determined by the teacher and applied to everyone in the class. Assignments related to minimal objectives were covered first. Each assignment was completed and checked in class as a group. At the end of the class, students reported their scores on the assignment orally to the teacher who recorded them in the grade book. (Corresponding activities for IS students are described in the section "Teacher Activities".)

In the IS students were required to pass the minimal objectives
TABLE III

SAMPLE UNIT ASSIGNMENT SHEET

Unit IV: Pronouns

Activities and Objectives

When you pass objectives 1, 2, 3, & 4 you automatically have earned thirty points and a grade of "C" for this chapter. If you passed objectives 1, 2, 3, or 4 on the pre-test or if you work quickly and pass all of them you may make a deal with me to work on some other assignments for more points. If you do this you will have your own assignments and objectives and you won't have to do what the rest of the class does.

EVERYONE MUST PASS OBJECTIVES 1-4

1. Given a sentence you must identify all the pronouns in the sentence correctly 80% of the time (read page 96 in your book; do ditto I). Quiz I-A or I-B. (5 points).

2. Given a sentence with a pronoun in it, correctly tell the noun that the pronoun refers to 80% of the time. (Do exercise B on p. 97.) Quiz II-A or II-B. (5 points).

3. Given a sentence with an underlined pronoun tell the person and number of the pronoun correctly 80% of the time. (Read pp. 98 and 99 in your book; do dittos III-A or III-B. Quiz III-A or III-B.) (10 points).

4. Write a sentence using nouns as subjects and objects. Underline the subject and object in the sentence and write a pronoun which could be used in place of the subject above the subject and one that could be used in place of the object above the object 100% of the time. (Read pp. 102-106 in your book; do exercises A and B on p. 106 in your book. Do ditto IV. Quiz IV-A or IV-B.) (10 points.)*

If you finish objectives 1-4 early, you may choose the objectives you want to work on from the following list. Here is how you will be graded.

*Objectives 1-4 are minimal objectives.
TABLE III (Continued)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Points</th>
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<tbody>
<tr>
<td>A+</td>
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<tr>
<td>A</td>
<td>90</td>
</tr>
<tr>
<td>A-</td>
<td>80</td>
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<tr>
<td>B+</td>
<td>70</td>
</tr>
<tr>
<td>B</td>
<td>60</td>
</tr>
<tr>
<td>C+</td>
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<tr>
<td>D+</td>
<td>20</td>
</tr>
<tr>
<td>D</td>
<td>15</td>
</tr>
<tr>
<td>F</td>
<td>less than 10</td>
</tr>
</tbody>
</table>

5. Supply the correct possessive form of a given pronoun in a sentence 80% of the time. (Read p. 100 in your book; do exercise B on p. 101 of your book.) Quiz V-A or V-B. (10 points).

6. Given a sentence with "is", "are", "was", or "were" as the verb, choose the correct pronoun to complete the sentence 80% of the time. (Read p. 107; do the exercise on p. 107). Quiz VI-A or VI-B. (10 points).

7. Given a paragraph written with no pronouns, rewrite the paragraph substituting pronouns for nouns where it is appropriate in order to avoid repetition of nouns. You must insert at least three pronouns in each paragraph, and they must be correct in person, number, and case (case means whether it is subjective or objective). (Do ditto VII, Quiz VII-A or VII-B.) (10 points.)

8. Complete the creative writing ditto #8. You may do anything you want for the sections called, "costume designer", "idea men", "word specialist", and "name dropper". In the section called "you are a writer" you must write at least...**.

**All objectives after #4 are above minimal objectives. In actuality there were a total of 7 above minimal objectives in this instructional unit.
before they were allowed to do activities related to other objectives. After passing the minimal objectives for a unit, the students were allowed to work on the remaining assignments at their own speed and in any order. Since it was possible for students to work at different rates in the IS it was more difficult for the teacher to keep track of each student's progress. Therefore, two additional means of recording assignments were used in this system. Students were given Unit Point Sheets at the beginning of each unit to keep track of their own points and objectives passed (see Table IV). As the teacher handed a passing quiz back to each student, he instructed them to record their points on a wall chart and allowed time to do so. The teacher then also initialed the blank corresponding to that objective on the Point Sheet. There were no other prompts or contingencies placed on the students to maintain the records, however. The wall chart permitted the teacher and students to see at a glance which students had passed which objectives. Upon observing that a particular student was not progressing through a unit (as indicated by the absence of points on the wall chart) the teacher occasionally negotiated a due date for a new objective with the student and wrote that due date on the Point Sheet (see Table V).

Pretests

Pretests covering each unit's minimal objectives were given at the beginning of each unit in both the Group and Individualized
### TABLE IV

**SAMPLE UNIT POINT SHEET**

<table>
<thead>
<tr>
<th>NAME: <strong>Becky A.</strong></th>
<th>UNIT: <strong>IV PRONOUNS</strong></th>
</tr>
</thead>
</table>

#### Required Objectives

<table>
<thead>
<tr>
<th>Objective</th>
<th>Points</th>
<th>Date</th>
<th>How Passed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>5</td>
<td>3/9</td>
<td>quiz</td>
</tr>
<tr>
<td>2.</td>
<td>5</td>
<td>3/4</td>
<td>pretest</td>
</tr>
<tr>
<td>3.</td>
<td>10</td>
<td>3/8</td>
<td>quiz</td>
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<tr>
<td>4.</td>
<td>10</td>
<td>3/9</td>
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#### Extra Objectives

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<th>Date Passed</th>
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<td>3/15</td>
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<td>6.</td>
<td>3/19</td>
<td>10</td>
<td>3/15</td>
</tr>
<tr>
<td>7.</td>
<td>3/22</td>
<td>10</td>
<td>3/22</td>
</tr>
<tr>
<td>8.</td>
<td>3/25</td>
<td>10</td>
<td>3/22</td>
</tr>
<tr>
<td>9.</td>
<td>3/25</td>
<td>10</td>
<td>3/24</td>
</tr>
</tbody>
</table>

10. 
11. 
12. 
13. 
14. 
15. 

---

**Spelling Assignment:**

Unit: _____ Pages: _____

**Total Chapter Points = ____**

**Grades**

Student: A+ = 100  B = 60  D+ = 20
A = 90  C+ = 40  D = 15
A- = 80  C = 30
B+ = 70  C- = 25

---

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<table>
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<th>UNIT 4</th>
<th>NAME</th>
<th>MINIMAL OBJECTIVES</th>
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<td>Case</td>
<td>5 10 10</td>
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systems of instruction. Table VI shows a sample pretest. There was always one test question consisting of several items for each unit minimal objective. (See Table VI.)

In the GS, the pretest was solely for the purpose of this study in order to avoid the possibility that only students in the IS might benefit from "pre-sensitization" to unit objectives (Campbell and Stanley, 1966). Students in the GS were told that pretests would not be graded and that their purpose was simply to show them the nature of the new unit. Under the GS, neither teacher nor student activities were in any way adjusted as a result of pretest scores.

In the IS of instruction, pretests were scored overnight by the teacher. For every pretest question with the specified number of items correct, a student received credit for having passed the corresponding minimal objective, and was therefore excused from the exercise and quiz associated with that objective. On the day following the Unit Pretest, students in the IS received their Unit Point Sheets with any minimal objectives passed on the pretest already recorded along with the points earned for each objective.

**Teacher activities**

In both systems the teacher's activities during class consisted mainly of: (1) a brief lecture, (2) a demonstration and/or explanation of exercises in response to students' questions, and (3) providing feedback on completed student assignments.

Classes under the GS began with a lecture which identified and
TABLE VI
SAMPLE UNIT PRETEST

PRETEST: Unit IV
Pronouns

1. Underline all the pronouns in the following sentences:
   a. I gave the book to her.
   b. They are at the seashore.
   c. That book is here.
   d. This is your car.
   e. John and Mary walked seven blocks in Chicago without getting mugged.

2. Circle the word that the underlined pronoun refers to in each sentence:
   a. Ted went home. He left five minutes ago.
   b. After we painted the house it looked much better.
   c. The rangers asked the visitors not to feed the bears because they are dangerous.
   d. Alfred, will you get me a glass of milk?
   e. My name is Gunther. Will you dance with me?

3. Tell the person and number of the underlined pronouns in the following sentences.
   a. I wish you would go away. Person _______ Number ___
   b. You people should study. Person _______ Number ___
   c. They ate the whole thing. Person _______ Number ___
   d. We wish you a merry Christmas. Person _______ Number ___
   e. It was the blob that devoured St. Louis. Person _______ Number ___

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4. Write two sentences in the spaces below using regular nouns for subjects and objects. Underline the subjects and objects in each sentence. Then write a pronoun above each underlined noun that you could substitute for that noun.

Sentence # 1:

Sentence # 2:
briefly explained the day's assignment. Following the lecture
the students all began work on the assignment. To receive help,
students raised their hands and asked questions either publically
or privately to the teacher. Thus, the teacher gave explanations
and demonstrations to individuals or to the entire group. Near the
end of the period students exchanged their papers, the teacher read
the answers to the exercises, and the students checked each other's
papers. Finally, students returned their papers to each other and
read their scores to the teacher who recorded them in the grade
book.

In the IS, the teacher listed the day's lecture topic on the
blackboard at the beginning of the class. The lecture topic for
the beginning of the hour was the same in all sections and was
determined by the GS's progress through assignments. The topic was
referenced to one of the objectives from the Unit Assignment Sheet.
Students could go to the lecture area or to their seats to begin
work on an exercise. If no one came to the lecture area, the
teacher would either move about the room to give individual students
help, or gather a group of students who wanted help on a particular
unit assignment. During the last ten to fifteen minutes of class
the teacher handed out individual quizzes to students who had turned
in exercises during the hour. As these students finished the quizzes,
the teacher corrected as many as he could during the hour and com­
pleted any others overnight. Hence, students in the IS received
feedback on their quizzes either immediately or at the beginning
of the next class period.
Evaluation and grading

Both systems used the number and weight of objectives passed to establish student grades.

In order to receive credit for passing an objective students in the IS had to first complete the exercise intended to teach that objective. The teacher checked the exercise when it was complete. Students who had completed it satisfactorily were then given a quiz designed to test mastery of the objective. If a student had not completed the exercise correctly the teacher required that errors be corrected before the quiz was made available to that student. If a student failed to meet the criterion for mastery on a quiz the assignment corresponding to the quiz had to be reviewed and an alternate form of the quiz was then administered. The criterion for mastery of the quiz question was always stated on the Unit Assignment Sheet. (See Table III). Each objective was worth a specified number of points as determined by the teacher. The grade-point scale listed on the Unit Assignment Sheet shown in Table III was used in every unit. The point value of objectives was always arranged so that the minimal objectives were worth 30 points or a grade of "C". The other objectives were weighted according to the teacher's judgement of their difficulty and/or importance. The total point value of any unit's objectives was always at least 100 points and sometimes exceeded 100 points.

In the GS, students earned points and passed objectives solely on the post-test which was at the end of each unit and covered all
the unit objectives. All unit exercises had to be turned in, and this was assured since exercises were completed as a group in class. Students who were absent made individual arrangements with the teacher to make up missed material. Students absent on the day of the test also made individual arrangements to make up the tests or were scored zero.

In the IS students earned points and passed objectives either on the pretest or on the single-objective quizzes which were available in any class period when a student completed and submitted the corresponding exercise. Each quiz covered only one of the unit objectives and consisted of questions identical in form to the pretest questions, and to the GS posttest questions, but with different items. There were from two to four forms of each quiz for students not passing on their first attempt.

Review

Following every two regular units all classes were given a review test which covered minimal objectives from both of the previous two units. Both the Group and Individualized systems took identical review tests on the same day. For the students in the GS this test resembled a typical unit posttest except that it covered objectives from two units. For the students in the IS it differed from the usual testing format in that the test covered several objectives (unlike the single-objective quizzes administered during regular units). Review units never presented any new
material or objectives that both systems had not previously covered.

Preparation for review tests was identical in both instructional systems. The review consisted of the teacher repeating demonstrations of exercises from the previous two units. He also orally questioned students in class over the review exercises. The amount of time spent preparing for a review test was left to the teacher's discretion and varied considerably across the three review units. (See Table I.)

Summary

Tables VII and VIII show flow diagrams that summarize the Group and Individualized systems of instruction in terms of the sequence of activities and the time spent in each activity across the two systems.

As can be seen in Table VII, in the GS the daily class began with a ten to fifteen minute lecture on the day's assignment. Then the entire class worked at their seats on the same assignment. After twenty to twenty-five minutes, they exchanged papers and corrected one another's work as the teacher read the answers. Finally, the students orally reported their scores on the assignment when the teacher called their names. At the end of the unit when the class had completed all the chapter assignments in the above manner, the unit test was administered to the entire class.

In the IS the class began with a ten to fifteen minute optional lecture. (See Table VIII). Students who had passed the objectives
TABLE VII. FLOW DIAGRAM OF CLASS STRUCTURE OF GROUP SYSTEM (GS) OF INSTRUCTION

State Set A

1. Lecture
   Enter

2. Seatwork on group assignment
   10 minutes
   Students exchange papers
   Student asks question: answer given

3. Teacher assistance
   Teacher answers

4. Teacher reads answers
   Students score papers

5. Teacher records scores
   Exit

State Set B

1. Test over all unit assignments
   Enter

   55 minutes
TABLE VIII. FLOW DIAGRAM OF CLASS STRUCTURE OF INDIVIDUALIZED SYSTEM (IS)

State Set A
1. Lecture topic on board
   - Lecture criteria met
   - Lecture criteria not met
2. Lecture
   - 10 minutes
3. Seatwork without teacher
   - 10 minutes
4. Seatwork without teacher
   - Assignment not acceptable
   - Assignment completed and turned in
   - Student asks question
   - Answer given
5. Teacher assistance
6. Teacher checks assignment
7. Teacher hands out individual quizzes
8. Quiz corrected
9. Teacher records points on point sheet
   - Meets criteria
   - Does not meet criteria and variable time
10. Teacher dismisses
   - Points recorded

State Set B
1. Class in session
   - 55 minutes
2. Wall chart recording
   - Points recorded

Otherhappy
related to the day's lecture began work on their own assignments at their own seat. When the lecture ended, the teacher moved about the room for twenty to twenty-five minutes helping individual students with their work. During the last fifteen minutes of class, the teacher gave single-objective quizzes to students who had completed the corresponding assignment during the hour. Quizzes were corrected and returned either at the end of class or during the twenty to twenty-five minute work session on the following day, at which time students recorded their points and progress on the wall chart and on their point sheets. The IS class(es) continued in this manner until the GS class(es) had finished all unit assignments.

Dependent Variables

The major dependent variable recorded throughout the study was the number of objectives passed by each student in each unit. In the GS this was measured by recording the items passed on the unit test which included test items covering all the unit objectives. The unit test was given to the entire class on the final day of each unit. In the IS, the number of objectives passed was measured by recording the items passed on the unit pretest and the daily quizzes which were administered individually to students who requested them during the last fifteen minutes of each class period during the unit.

An attempt was made to measure the retention of objectives mastered by recording the number of objectives passed on the review
tests by each student. Unlike non-review units, the same measures were used in both the IS and GS classes during review units. Review tests, which covered minimal objectives drawn from the previous two units, were given to all students in all sections on the same day.

A third dependent variable was gains on the language arts usage subtest of the SRA achievement tests. The entire SRA achievement battery was given to all students in May of 1975 and again in May of 1976. Gains from 5/75 to 5/76 were calculated.

Finally, attendance data were collected throughout the study to determine if student attendance varied across systems of instruction.
RESULTS

Minimal Objectives Passed

As can be seen in Figure 1 the percentage of students passing all the minimal objectives in a unit increased when the IS was implemented in sections 6A and 6B. This increase is apparent when comparing the average class percentages within sections and across units or, when comparing the average class percentages across sections and within units.

First, comparing within section 6A, the percentage of students that passed all minimal objectives rose from an average of 50% in units one through three (Group System) to an average of 74% in units four through nine (Individualized System). Within section 6B the increase was from 36% in units one through six (Group System) to 58% in units seven through nine (Individualized System).

Comparing across sections for units one through three, 6A had an average of 50% of its students who passed all the minimal objectives, 6B averaged 46% and 6C averaged 54%. In units four through six, section 6A switched to the IS and averaged 63% total mastery rate compared to 22% and 30% for sections 6B and 6C respectively. In units seven through nine, 6A and 6B both used the IS and averaged a total mastery rate of 79% and 58% respectively, while 6C remained under the GS and averaged a total mastery rate of 32% on minimal objectives.

To summarize these gross measures, the three sections performed
Figure 1. Percentage of students passing all minimal objectives for each unit in sections 6A, 6B, and 6C
(● = review unit)
quite comparably on units one through three while all used the Group System. When section 6A switched to the IS in units three through six, it averaged 33 and 41 percentage points better than 6B and 6C, respectively, which remained in the GS. Finally, in units seven through nine, 6A and 6B both used the IS and performed 47 and 26 percentage points, respectively, above section 6C which remained in the GS.4

A more detailed analysis of student success rate on minimal objectives is presented in the frequency distribution shown in Figure 2 which shows the distribution of all students, both at and below 100% mastery of minimal objectives. Even more clearly than in Figure 1, it can be seen that a higher percentage of students passed more objectives under the IS than under the GS. In addition, the pattern of distribution indicates several possible effects of the Individualized System. First, in 6A at least, the IS apparently had a considerably stronger effect in non-review units than in review units. Second, there were fewer students in the IS who did not pass all minimal objectives during non-review units than in the GS. Third, the IS students who did not pass all minimal objectives generally scored higher than their counterparts in the GS. Finally, 

4The dependent variable was measured somewhat differently in review vs. non-review units and in the IS vs. the GS. In non-review units mastery of objectives in the IS was based on items passed on the pretest and/or daily single-objective quizzes. In the GS mastery of non-review objectives was based solely on items passed on the unit test which covered all the unit objectives. In review units both the IS and GS mastery calculations were based on items passed on the review unit test which covered all the review objectives.
Figure 2. Frequency distribution of percentage of minimal objectives passed
there were a number of students exposed to both the GS and the IS who consistently performed at very high or very low levels irrespective of which system of instruction was in effect.

The first effect listed above may be artifactual and will be considered later. (See Discussion and Figure 8). However, in view of the small differential effect of the IS and GS in review units, the remaining results will focus on non-review units. The last two effects listed above concern non-review units and require further analysis.

Each of the three class sections could be characterized by three types of students:

(1) Those who performed at a 100% mastery rate for minimal objectives on all non-review units.

(2) Those who performed differentially from unit to unit. That is, they achieved 100% mastery only on some non-review units.

(3) Those who never performed at 100% mastery for minimal objectives on any non-review unit.

As can be seen in Figure 3, section 6A had eight students who passed all the minimal objectives in all non-review units, regardless of the system of instruction. There were four students who never achieved 100% mastery in a non-review unit, while nine students performed at least somewhat differentially from unit to unit. In section 6B there were five students who always passed all the minimal objectives in the non-review units, three students who never passed all the minimal objectives, and twelve students whose performance varied from unit to unit. In section 6C there
Figure 3. Class composition according to three patterns of student performance.
were two students who always passed all the non-review minimal objectives, eight students who never did, and twelve whose performance varied from unit to unit.

Student mastery of minimal objectives fell into three patterns: 24% of the subjects always performed at 100% mastery, 24% never performed at 100% mastery, and 52% fluctuated between total and partial mastery from unit to unit. Section 6A, which was under the IS for six units of instruction, had the highest concentration of students who always performed at 100% mastery (38%), and a low concentration of students who never reached 100% mastery (19%). Section 6B was under the IS during three units of instruction and had the next highest concentration of students who always performed at 100% mastery (25%), and the lowest concentration of students who never achieved 100% mastery (15%). Section 6C remained under the GS for all nine units and had the lowest concentration of students with total 100% mastery (9%), and the highest concentration of students who never achieved 100% mastery (39%).

Figure 4 shows individual data for two students per section chosen from among those whose mastery rates for minimal objectives varied from unit to unit. The individual data displayed in Figure 4 for section 6A were chosen as representative of all of the nine students whose mastery rates varied across units. Of these nine students none had 100% mastery rates in units I and II. All nine had 100% mastery rates in units IV, V, VII, and VIII except three students each of whom missed only one minimal objective in one of
Figure 4. Percentage of minimal objectives passed by two representative students from each section (* = review unit)
these four units. All nine performed at consistently higher mastery rates under the IS than under the GS.

Similarly the data displayed in Figure 4 for section 6B was chosen as representative of the 12 students in 6B whose mastery rates varied from unit to unit. None of the 12 students had a 100% mastery rate in more than two of the first four non-review units. Nine of the 12 had a 100% mastery rate on one or both of the final two non-review units. Eight of the students performed consistently at higher mastery rates under the IS, while the remaining four students performed at roughly the same mastery rates as under the GS.

Finally, the individual data presented for section 6C in Figure 4 were also chosen as representative of the 12 students in 6C whose mastery rates varied from unit to unit. On the average these students performed at 100% mastery on two to three non-review units. In units I and II an average of 79% of these 12 performed at 100% mastery. In units VII and VIII an average of 25% of these 12 performed at 100% mastery.

In summary, the IS showed a strong, consistent positive effect in section 6A on the mastery rates of those students whose mastery fluctuated. In section 6B, where the IS was in effect for only two non-review units, the effect on student mastery was also positive, but less consistent for students whose mastery fluctuated. Performance in 6C for this same category of students generally declined in progressive units.
Above Minimal Objectives Passed

Figure 5 shows the average percentage of above-minimal objectives passed by students in 6A, 6B, and 6C. Comparing across sections, within units I through III when all utilized the GS, section 6A averaged 34%, 6B averaged 49% and 6C averaged 40%. For units IV through VI, section 6A switched to the IS and averaged 56%, while 6B and 6C averaged 48% and 51%, respectively. In units VII and VIII, 6A and 6B used the IS and averaged 62% and 52% respectively, while 6C remained under the GS and averaged 45%.

A more detailed analysis of student mastery of above-minimal objectives is presented in Figure 6. In units I through III, while all three sections used the GS, the pattern of mastery was very similar in all three classes. In units IV and V, for which 6A switched to the IS, more students passed higher numbers of the above-minimal objectives in section 6A than in 6B and 6C. For example, in unit IV, 79% of the students in section 6A passed two or more above-minimal objectives compared to 53% of the students in 6B and 62% of the students in 6C. In the second review unit (VI) more of the students in 6B and 6C (both utilizing the GS) tended to pass high percentages of the above-minimal objectives, however. Specifically, 30% of the students in 6A passed three or more above-minimal objectives in unit VI compared to 50% of the students in 6B and 50% in 6C. But in the final two non-review units (VII and VIII) both sections 6A and 6B used the IS and for the most part performed at above-minimal objective mastery levels as high or
Figure 5. Average percent of above-minimal objectives passed by students in 6A, 6B, and 6C.
Figure 6. Frequency distribution of number of above-minimal objectives passed
higher than the levels achieved by 6C. For example, in unit VIII, 75% of the students in section 6A and 65% of those in 6B passed two or more above-minimal objectives compared to 45% of those in 6C. The third review unit (IX) consisted solely of minimal objectives due to time limitations in completing the study before the school year ended. As a result there were no above-minimal objective mastery rate data for this last unit.

Figure 7 presents the performance of six individual students on above-minimal objectives. These are the same six students whose performances on minimal objectives were presented in Figure 4. These students' performances were again representative of each of the three sections in that the percentage of above-minimal objectives a student passed under the IS was generally as high or higher than in the GS. Furthermore, as students reached total mastery of minimal objectives in the IS, they typically maintained or increased the percentage of above-minimal objectives passed.

For example, the two students from 6A averaged 47% and 27% of the above-minimal objectives passed over all units under the GS and rose to an average of 60% and 72% respectively over all the units under the IS. The two students from section 6B passed an average 55% and 37% of above-minimal objectives over all units taught under the GS and rose to averages of 83% and 73% respectively over all units under the IS. The two students from 6C who were always under the GS passed an average of 49% and 34% of the above-minimal objectives over all units.
Figure 7. Percentage of above-minimal objectives passed by two representative students from each section (* = review unit)
To summarize student performance on above-minimal objectives, the sections under the IS tended to perform as well or slightly better than those in the GS, except in the second review unit (VI). In general, individual students in the IS were able to maintain or increase the number of above-minimal objectives they passed at the same time as they were greatly improving their minimal objective mastery rate.

**Review Units**

As can be seen in Figures 1 and 2, all three class sections performed at a low mastery rate for minimal objectives on the first review unit (III) compared to their performances on the preceding two units (I and II). Section 6A averaged 60% of its students who mastered all the minimal objectives on units I and II and declined to 30% on unit III. Section 6B declined from an average of 60% in units I and II to 16% in unit III. Section 6C declined from an average of 56% in units I and II to 50% in unit III.

In the next three units, section 6A performed at higher mastery levels on units IV and V but at a comparatively lower level on the corresponding review unit (VI). Sections 6B and 6C performed at low mastery rates on all three of these units, but unlike section 6A the review unit performance was better than the earlier two non-review unit performances for both sections. Specifically, 6A declined from an average of 90% of its students passing all minimal objectives in units IV and V to 10% in unit VI. In contrast,
sections 6B and 6C rose from respective averages of 25% and 23% of their students passing all minimal objectives to 30% and 45% in unit VI.

In the last block of three units (VII, VIII, and IX) the sections under the IS tended to perform at high mastery levels on the two non-review units and decline on the review unit, while 6C performed at relatively low mastery levels on the non-review units and improved its overall mastery level in the review unit. Sections 6A and 6B dropped from respective averages of 82% and 60% of their students passing all minimal objectives in units VII and VIII to 71% and 55% in unit IX. Meanwhile section 6C rose from an average of 25% of its students passing all minimal objectives on units VII and VIII to an average of 47% on unit IX.

To some extent, review unit mastery levels averaged across sections improved with experience in taking review tests, and as material covered by review units was presented over less elapsed time. The average mastery rate for minimal objectives for unit III was 69%, 67% for unit VI, and 75% for unit IX. The material covered by unit III was presented over a total period of 72 elapsed days (due to Christmas vacation), 53 days for unit VI and 38 days for unit IX. (See Table I and Figure 8).

Figure 8 shows an analysis of review test performance by separating the objectives drawn from different non-review units. Invariably students in all sections tended to pass review objectives drawn from the earlier unit than from the more recent non-review unit.
Figure 8. Average percent objectives passed on each review unit from the two non-review units.
SRA Achievement Scores

Figure 9 shows a frequency distribution of changes in student performance on the language arts subtest from May of 1975 to May of 1976. The SRA test was not sensitive to any systematic difference between sections. Section 6A had nine students who showed gains of less than a year or losses in achievement, and eight students who showed gains of a year or more. Section 6B had nine students who showed gains of a year or more, and 10 students who gained less than a year or lost achievement. Section 6C had eight students who showed achievement gains of a year or more, and 11 students with gains less than a year or losses. There appears to be no systematic relationship between gains on the SRA test and class section. Thus, the SRA achievement test scores indicate that the two instructional systems did not produce any differential changes in skills measured by this achievement test and reaffirm that the three class sections came from the same population.

Attendance

Figure 10 shows the total absences for each section in each block of three units of instruction. Section 6A had the highest number of absences in the first block of units while all sections were in the GS. In the second block of units, 6B and 6C did not vary their absences significantly from the first block of units, but section 6A increased by 31 absences in a 41 day period. In the last block of three units while 6A and 6B were both in the IS
Figure 9. Change in grade equivalent score on usage subtest of SRA achievement test from 5/75 to 5/76
Figure 10. Total number of absences for each section in blocks of three units.
Absentee rates were reduced by 46 and 14 days in a 36 day period. Section 6C held roughly constant throughout the last six units. There were no apparent functional relationship between attendance and the system of instruction in effect. (See Figure 10.)

Point Sheets and Wall Chart

Although no systematic data were recorded concerning whether students in the IS maintained their own records of their point totals, informal reports indicated that both the point sheets and wall chart were always kept up to date by all students. There was a low probability that students would not have maintained their point sheets since the teacher initialled the blank on the sheet corresponding to each objective passed as he handed back the corrected quizzes to students. The teacher's request to see the point sheet to initial it probably served as a prompt to maintain the Point Sheet. The wall chart was left entirely to the students to fill out; however, it was kept up to date equally well. In light of this fact, it seems reasonable to suggest that the opportunity to post one's points acquired some conditioned reinforcer properties for the students in the IS.
DISCUSSION

The major goal of this study was to develop an individualized system of instruction at the elementary level that would allow a teacher to effectively perform the basic functions specified by Michael (1969, 1974) yet still be applicable given limitations in resources typical of most elementary classes. Since the Keller system was found to be among the most effective, explicit, and complete systems described for helping teachers perform these functions, an analysis was made of why the Keller System, though potentially the most beneficial instructional system for early ed, was primarily restricted to college-level courses. Such an analysis revealed that effective functioning in a PSI system requires some self-management skills on the part of its students as well as considerable resources (e.g., proctors). However, most elementary school students probably lack an adequate self-management repertoire and most elementary school teachers are not typically in a position to requisition additional staff resources.

Nevertheless, an attempt was made to overcome these difficulties and develop, implement, and test a Keller-like course in two sections of a sixth-grade language arts class. The problem of lack of self-management was partially overcome by allowing self-pacing to occur within two to three week units rather than the entire school year. In addition, self-recording of behavior by students was incorporated into the system in order to maximize the probability of students
succeeding in such a self-paced, individualized system and compensate for the absence of proctors in the elementary setting. By self-recording their progress through the academic materials and activities in a Keller-style course, students presumably came in contact with stimuli which prompted and maintained a schedule of work completion, and at the same time relieved the teacher from part of the considerable burden of monitoring, prompting, and consequating the responses of each individual student in the group. The results of this study indicate for the most part that this attempt at a modified PSI course was successful in that the IS clearly increased the number of minimal objectives passed in non-review units.

The argument could be raised that IS students increased the number of minimal objectives passed at the expense of above-minimal objectives. Figures 5 and 6 indicate that this was not the case. IS students increased their rate of passing minimal objectives while maintaining or slightly improving upon their above-minimal objective mastery rates.

Various researchers (e.g., Morris and Kimbrell, 1972) have reported that college-level PSI courses have had little or no positive effect on poor students (i.e., those with low GPA's and/or standardized test scores) and that there are frequently considerable numbers of drop-outs from PSI courses. There were no analogous findings in this modified Keller course at the elementary level. The fact that there were roughly twice as many students who never
achieved 100% mastery in 6C is suggestive that the IS (which was never in effect in 6C) may in fact have had a positive effect on a larger portion of poor students than the GS did. While this is somewhat speculative, the fact that 6A and 6B also had much higher concentrations of students who always reached 100% mastery is further indication that the IS may have had some positive effects on students across all ability levels. Although there were four students in 6A and three students in 6B who showed no change in mastery of minimal objectives, no student ever performed better under the GS than the IS. While there is no direct analogy at the elementary level to dropping out of a college course, Figure 10 shows no functional relationship between attendance and system of instruction. Therefore, it is safe to say that the IS certainly did not negatively affect any student's performance in terms of academic behavior or attendance.

Sherman (1974) has suggested that a possible cause for failure of college students in PSI courses is the lack of adequate self-control and study skills. It is possible that by the inclusion of self-recording techniques in the IS, this particular individualized system helped avoid some of the failures encountered in college-level self-paced courses. Still, there were seven students in 6A and 6B who continued to fail under the IS. The causes for their failure to improve under the IS may have been due to several factors. Perhaps the self-recording alone was insufficient as a self-control
technique to maintain and reinforce adequate rates of work completion. Also, the three to four week length of some units may have been too long a period of time at which to require self-pacing for these seven. More likely, however, is the possibility that the level of the instructional materials was above the level of pre-requisite skills possessed by these students. This supposition is supported by the SRA achievement scores available for six of these seven students. Their average reading performance was at the twelfth percentile and three years behind grade level.

The issue of retention in PSI courses has been raised by McMichael and Corey (1969) and Cooper and Greiner (1971) as mentioned previously. Generally, retention has been found to be superior in PSI courses. As can be seen in Figures 1 and 2, the retention of material by students in the IS as compared with those in the GS was extremely unfavorable in the second review unit (VI) and somewhat favorable in the third review unit (IX). From Table I it can be determined that the second review unit (VI) consisted solely of a test given in one day with no time spent in class to prepare the students for the review test. While neither the students under the GS nor the IS performed at high levels on the review test, the students' performance in 6A (IS) represented a decline from their high performance on the previous two units which were being reviewed. Students in 6B and 6C (GS) on the other hand showed slight improvements over their low performances from the previous two units. These data can probably be best accounted for by
differences in grading and evaluation between the two systems. While the GS always involved a single unit test covering all unit objectives at the end of a unit, the IS had only a unit pre-test and then simple-objective quizzes that were administered daily throughout the unit. The IS students were therefore unaccustomed to tests with items related to a variety of concepts. For example, students in section 6A learned to identify nouns in unit IV, and considerably later learned to identify pronouns in unit V, but the unit materials were not programmed to teach students to distinguish the concept "noun" from the concept "pronoun". Thus, when students in 6A were presented with the second review test (VI) which had some items requiring each discrimination, performance deteriorated probably because the students had never been required to perform both discriminations on the same test. As shown in Table I, the last review unit (IX) involved four days of in-class review which consisted of teacher demonstration and oral question and answer sessions for all three sections. The IS students performed at higher levels than their GS counterparts after such preparation, but still performed at levels somewhat lower than their own previous performances on the same material.

Although the review tests were intended to function as measures of retention they may also have measured the ability of students to discriminate among the concepts taught from unit to unit (as in the examples given, "noun" vs. "pronoun"). If this is true, the low performance of the IS students on review tests may not be a
function of "forgetting" in the usual sense so much as it was a function of poor materials which did not systematically test to assure that all the defining features of each concept were taught. The review tests, by testing a variety of related concepts in juxtaposition would expose this weakness in IS students, whereas the single-objective quizzes during non-review units would not. 

It is interesting to note that a second form of the second review test (VI) was given by the teacher for his own satisfaction following the poor first performance of the students. On the second form of the review test the percentage of students in 6A who passed all minimal objectives rose from 10% to 30% while the percentages in 6B declined from 30% to 25% and in 6C from 45% to 20%. The second form of unit VI was given following two to three days of review. It is possible that these results were due to the history that students in 6A had with respect to responding to feedback on assignments and quizzes as a discriminative stimulus to remediate their errors and retake an alternate form of the quiz on the next day. Students in the GS, on the other hand, were accustomed to receiving daily feedback on assignments, but that feedback did not serve any function in determining the next day's activities. Therefore, when all three sections received feedback on the review test it is possible that some of the students in 6A had some tendency to respond to the feedback as an SD to re-study and correct errors despite the fact that no such responses were explicitly required by the teacher during the review period. The
students in 6B and 6C would have had no such tendency based on their history with feedback in the previous units. The increasing numbers of students in 6A and 6B who mastered all minimal objectives in successive review units as compared with the nearly constant number in 6C may have been the result of students in the IS becoming increasingly effective in learning to respond to feedback as an SD to correct their errors or establish new stimulus-response relationships.\(^5\)

An interesting but perhaps puzzling aspect of the pattern of retention under both systems of instruction is presented in Figure 8. All three class sections consistently passed a higher percentage of review objectives that were drawn from the earlier rather than the more recent unit being reviewed. At first, this finding seems plausible in that the teacher may have stressed the earlier unit in the two to three day review period before a review test. However, there was no such review period preceding the second review test (VI) and the differential retention in favor of earlier objectives was even stronger. While such issues have been addressed by some learning theorists in terms of "proactive" or "retroactive" inhibition (e.g., Underwood, 1957) or "probability learning" (Estes, 1964), the variables responsible for this outcome are not clear.

One relevant issue may be the similarity of content in units

\(^5\)In any case, based on the poor performance of all three sections on the first form of the unit VI test and particularly 6A's poor performance, it was determined to provide several days for review in class prior to the third review test.
being reviewed. While the topics covered by the first and third review were quite dissimilar, those covered in the second review were very similar. It is conceivable that this is another reflection of the poor sequencing and/or lack of cumulative programming in the course materials. Perhaps if the units had been developed and sequenced according to a concept hierarchy (Markle & Tiemann, 1970; Becker, Engelmann, and Thomas, 1975) the students would have been more effective in discriminating related concepts from one another and generalizing from teaching examples to novel examples. In some ways the pattern of retention indicates that the students may not have had such skills.

It appears as if the IS may have been an effective management system that brought students in contact with mediocre learning materials. As a result, IS students performed much better than GS students in the short-term, but due to a program of instruction that may have been poorly sequenced and non-cumulative there were no great long-term differences in "retention" (as measured by review tests). Even so, if students were learning self-management skills this may be a strong argument for self-paced courses at the elementary levels even before the materials are perfected since the IS classes performed as well or somewhat better than the GS class when time to review was provided in class. It should be noted that Miller and Weaver (1976) have demonstrated successful concept programming or abstract learning in a PSI course. The development of materials and procedures for such programming can be empirically
tested over a period of time, but the materials for this study were written just prior to their usage, and therefore would require considerable revision to be maximally effective as an instructional package.6 Although the development of materials and procedures required considerable time outside of class for the teacher, this time was roughly equivalent across the two systems of instruction. Moreover, the amount of time spent in materials development would be expected to decline each year since the teacher would only have to revise previously written materials.

Despite the disappointing performance of IS students on the review tests and the absence of any differential effects on SRA scores, the mastery rates of IS vs. GS students for both minimal and above-minimal objectives indicate that an individualized system such as the one implemented in this study may have considerable

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6Resnick, Wang, and Kaplan (1973) have presented a systematic method for empirically developing an effective curriculum. In order to develop an effective sequence of objectives according to the method presented by these authors it is necessary to organize a system around a set of objectives that will allow pretesting, self-pacing, remediation, and systematic recording of student progress. While the authors indicate that the "form" of instruction used may vary it is interesting to note that the components of the system specified are remarkably similar to the components of Keller-style courses. Hence, self-paced courses with mastery requirements for advancement may serve not only as good management systems to assure that students come in contact with learning materials; they may also be the ideal setting in which to empirically develop programs which can be continually revised and improved to maximize the quality as well as the quantity of learning.
advantages at the elementary levels. This study demonstrated that a modified PSI course enables students to improve their mastery of a set of designated minimal objectives which is essential in any cumulative subject matter (e.g., math). These benefits were obtained while simultaneously avoiding procrastination (a commonly reported problem in college-level PSI courses) by allowing self-pacing only within two to three week units and the use of self-recording techniques. (In addition, the self-pacing feature was an advantage from a classroom management standpoint in that anecdotal reports by the teacher indicated that there were fewer disruptions in the IS than the GS from students who were either bored or confused by class activity.)

The implications of these results become even more striking in that all students (whether in the Group or Individualized System) had the same amount of class time to complete the activities for any given unit and that neither system ever required or assigned homework. Although the Group System of instruction may have given the teacher an illusory feeling that "all the material is being covered", when the Individualized System was compared with the GS in terms of mastery of the material, the IS was superior.

7The achievement tests were included in this study as a possible gross measure of differential growth in "language arts" skills across systems of instruction. No attempt was made to acquire or analyze the specific skills tested by the SRA achievement test as the course materials were developed. As can be seen in Figure 9 there were no apparent systematic differences across the three class sections. These results are not surprising in that it is highly probable that the course activities had little correspondence with the content of the SRA test. Given that this was the case, the SRA test then served as a measure of learning taking place outside of the course and therefore these data are not particularly interesting.
It is probable that the superior performance under the IS was largely due to the requirement for mastery of the minimal objectives before students in the IS were allowed to work on other activities. The mastery requirement would be difficult to employ in elementary education without the self-pacing feature of the Keller System since the students complete assignments in class and study time is therefore fixed and equal for all students (one of the reasons why the Keller System should be invaluable at this level of education). While it has been pointed out by Cooper and Greiner (1971) and others that simply offering chances to remediate errors may serve the same purpose as self-pacing in college-level courses, this assumes that the students can and will correct errors as well as study outside of class. This is unlikely, if not impossible, for the elementary student since study skills and basic familiarity with the area being studied may be required for such self-correction.

In considering the potential value of implementing Keller-like systems at the elementary levels of education it should be noted that there are some advantages inherent in the elementary classroom setting that many college students would not enjoy. Since elementary students complete their activities in class under the direct supervision of the teacher, it is possible for the teacher to monitor, prompt, and reinforce effective study behavior of students who are having difficulty in completing their assignments. In the college setting, it is probably the case that students who do poorly tend to avoid such contact or find it unavailable. In
short, PSI may be even better suited for elementary education than college-level courses. Another argument in favor of developing self-paced courses at early levels of education is that such instructional formats could provide students with opportunities to learn appropriate self-management skills and self-correction skills before going beyond a level at which they can be easily supervised by adults.

To summarize, it appears that a Keller-type course is a promising format for elementary education. For example, there are some indications that the mastery requirement for advancement (which probably cannot be enforced at the elementary level without self-pacing) may teach students to respond more effectively to feedback. In addition, a carefully structured, modified PSI course could provide a setting in which elementary students can be taught self-management skills. Finally, the PSI system, in addition to being a superior management system appears to be the better system in which to test and revise instructional materials (Resnick, et al, 1973).
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