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ABSTRACT

Personalized systems of instruction (PSI), also called individualized instruction or contingency-managed instruction, were developed in the mid-1960s at the college level by Fred Keller, a reinforcement learning theorist. The Keller plan consists of five features: self-pacing, unit mastery, student tutors, optional motivational lectures, and learning from written material. The Keller plan appears to work well because it is consistent with at least ten educational principles for which there is some empirical support, such as active responding and specification of objectives. Keller's plan may be implemented in five stages: assessing entering behaviors, specification of course objectives, selecting resources and activities, establishing the course, and evaluating student performance. Systematic efforts at evaluating PSI are beginning to appear. The two most extensive evaluations show that PSI students perform better on all types of examinations, have longer retention, and have more positive attitudes towards courses than students taking conventional, structure-type courses. (Author/ND)

PERSONALIZED SYSTEMS OF INSTRUCTION

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ABSTRACT

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Dr. Fred Keller, a reinforcement learning theorist, first introduced the Keller Plan, or what is also called PSI (Personalized Systems of Instruction) in the mid-1960's. The Keller plan consists of five features: self-pacing, unit mastery, student tutors, optional motivational lectures, and learning from written material. The Keller Plan appears to work well because it is consistent with at least ten educational principles for which there is some empirical support: active responding, positive conditions and consequences, specification of objectives, organization of material, mastery before advancement, evaluation/objectives congruence, frequent evaluation, immediate feedback, self-pacing, and personalization.

The Keller Plan may be implemented in five stages: assessing entering behaviors, specification of course objectives, selecting resources and activities, establishing the course, and evaluating student performance.

Systematic efforts at evaluating PSI have only begun to appear in professional journals. The two most extensive evaluations report that PSI students perform better on all types of examinations, have longer retention, and have more positive attitudes towards the course than students taking conventional structure type courses.

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INTRODUCTION

Personalized systems of instruction (PSI), also called individualized instruction or contingency managed instruction, were developed in the mid-1960's at the college level by Fred Keller, a reinforcement theory psychologist. Keller states that five features distinguish PSI from conventional lecture-type courses (Keller, 1968). First, instruction is presented primarily in written form. Second, lectures are used for motivational purposes only. Third, student progress in the course is self-paced. Fourth, student mastery of the units of the course is required. Fifth, student-tutors selected from previous classes are used to assist the students.

Many college courses now include most of the features of PSI. Instruction in these courses may consist of a number of small units of written material. A student may progress through the units at his own pace. However, a student must demonstrate that he has mastered the material in one unit before he may proceed to the next unit. Short quizzes are used to assess student mastery of the material in each unit. Student tutors correct quizzes and review quiz questions with the student. If a student's performance on a quiz indicates that he has not mastered the unit materials, the student must retake the quiz or an equivalent form until he has demonstrated mastery. A student's final grade in the course is usually dependent on the number of units mastered, and in some cases, on performance on one or more comprehensive examinations covering several units.

PSI POSTULATES

Personalized systems of instruction are based upon a number of assumptions concerning how students learn most effectively. Although the findings are not conclusive, educational research seems to support the following hypotheses upon which PSI is based (see Carr, 1962; Keller, 1967; Mager, 1968; and Kemp, 1971).

1. Active responding. Learning improves if the student is engaged actively with the subject matter and if the student actively responds to the subject matter.
2. Positive conditions and consequences. Learning improves if, whenever the student is responding to the subject matter, he is also in the presence of positive conditions and consequences. The more positive the consequences for the student, the more likely he is to learn.
3. Specification of objectives. Learning improves if the student knows precisely what learning outcomes are desired and reinforced by the instructor.
4. Organization of material. Learning improves if the subject matter is well-organized and presented in relatively small units of information.
5. Mastery before advancement. Learning improves if the mastery of material is required before advancing to new material.
6. Evaluation/objectives congruence. Learning improves if the evaluation of the student's performance is consistent with the specification of objectives given the student.
7. Frequent evaluation. Learning improves as the frequency of evaluation or feedback increases. Learning is more effective if it is spaced throughout the semester rather than massed at the time of a final examination.

8. Immediate feedback. Learning improves if the student is given immediate knowledge of the results of his performance. As time passes between the performance and the feedback, the student loses interest in the results and learns incorrect information.
9. Self-pacing. Learning improves if each student can proceed through the material at a speed commensurate with his ability and other demands upon his time.
10. Personalization. Learning improves as the student experiences increased interaction with his instructor or a tutor.

IMPLEMENTING A PSI COURSE

For the last five years, this writer has participated at Arizona State University in the development of a PSI course incorporating the above principles. The course is a required introductory but comprehensive overview of social science research methods (McGaw and Watson, 1976). We shall now describe how instructors can establish their own PSI course (Watson and McGaw, 1975).

There are five identifiable stages in the implementation of a PSI Keller Plan model: 1) assessing entering behaviors; 2) specifying objectives; 3) selecting resources and activities; 4) establishing and implementing the course framework; and 5) evaluating student performance.

ASSESSING ENTERING BEHAVIORS

The attempt or need to assess the behaviors of students entering a course is not unique to PSI. In almost any course, it is beneficial for the instructor to know about the needs, goals, characteristics, and capabilities of the students who will take the course. This becomes even more important for a PSI course, in which an effort is made to individualize course material and instruction to each student's situation.

Two of the most common, but unreliable, techniques of gathering this initial information are intuition and impression. Three somewhat reliable methods commonly are used in assessing entering behaviors. First, some instructors design and administer pre-tests on the information covered in the course or in particular units to determine the amount of pre-existing mastery of the course material. This technique can be used to place a student at a particular point within the sequence of material covered in the course. Simultaneous questionnaires can gather other information on the students unrelated to mastery of course content. A second technique of assessing entering behaviors involves the acquisition of such available data as test scores, grades, and transcripts that provide some insight to the student's academic skills. Finally, the instructor can schedule conferences with each student in order to determine his level and kind of motivation, home and work environment, self-concept, and amount of pre-existing knowledge of the course content area.

SPECIFICATION OF OBJECTIVES

The specification of course and unit instructional objectives is a key element of systematic instruction. An instructional objective is a statement that identifies a learning outcome intended by the course instructor (Gronlund, 1970: 1). If an instructor is able to define precisely what outcomes or student behaviors he expects as a result of his course and if he can specify them in terms of stated objectives, then several beneficial consequences follow (Gronlund, 1970: 4). First, the instructor has clarified for himself and his students precisely what students in the course are expected to do. Second, students are able to rely on the objectives as guides to direct their study efforts. Third, the objectives guide the instructor in the selection of course materials, teaching methods, and subject matter to be

covered. Finally, objectives also serve as a useful guide in the creation of evaluation instruments to measure the fulfillment of the objectives.

The use of instructional objectives is facilitated by the use of educational taxonomies (Bloom, et. al., 1956; Krathwohl, et. al., 1964). The widely accepted division of the taxonomy of educational objectives into the cognitive, affective, and psychomotor domains assists an instructor in identifying the learning outcomes he desires for his course. The cognitive domain includes knowledge, comprehension, application, analysis, synthesis, and evaluation as cognitive or intellectual skills. The affective domain relates to feelings and emotions, such as: receiving, responding, valuing, organizing values, and refers to actual physical skills, such as typing, operating a keypunch or calculator, or other physical operations.

Objectives for any one course may cover all levels of any, or all, of the taxonomic domains. Moreover, the use of objectives does not limit the instructor to the specification of only observable behavior. The student can be asked to feel, to create, to appreciate, to imagine, as well as to recall, to calculate, to explain, to analyze, and to evaluate. It is likely, however, that most instructors will prefer to base an evaluation of each student on the basis of some observable behaviors or performances. This does not mean that other objectives cannot be stated, but it is incumbent upon the instructor to specify which objectives will be evaluated. Then, both instructor and student will know the specific learning outcomes for which students will be held accountable.

SELECTING RESOURCES AND ACTIVITIES

Resources and activities must be selected on the basis of the course objectives and the assessment of entering behaviors. (Sometimes the lack of proper resources requires the restatement of objectives in order that

the objectives and course materials are consistent with each other.) In general, the PSI instructor must decide which objectives can be learned most effectively by the learner on his own, through group interaction, by formal presentation, or with individual tutoring. PSI normally can take full advantage of the wide range of resources and activities that are increasingly available to instructors (Wilson and Tosti, 1972: 43-60). In fact, since students differ a great deal in their responses to learning environments, PSI promotes the flexibility of varying the resources and activities for individual students.

In a self-paced PSI format, the utilization and selection of resources is complicated somewhat by the fact that students are spread out along the sequence of material in the course. The use of materials and techniques designed for use in groups are less easily implemented. Certain resources, such as films or speakers, often cannot be retained indefinitely while the students progress individually to that point in the course. Creation of learning resource centers has assisted somewhat in providing the capability to retain such resources over long periods of time. Activities requiring group interaction may necessitate some compromise of complete self-pacing in order to accumulate enough students at the same point in the progression sequence to engage in the interaction. A factor that complicates the selection of reading resources in a self-paced format is the fact that much of the initial understanding of the material by the students comes from their own reading of the resource material. The type of materials that are most effective in such a PSI instructional format are those that are consistent with the PSI postulates listed earlier. Especially appropriate are those materials that make use of objectives, that divide the material into relatively small chunks or units, that promote active responding in the students, and that provide immediate feedback to the student on the appropriateness of his response.

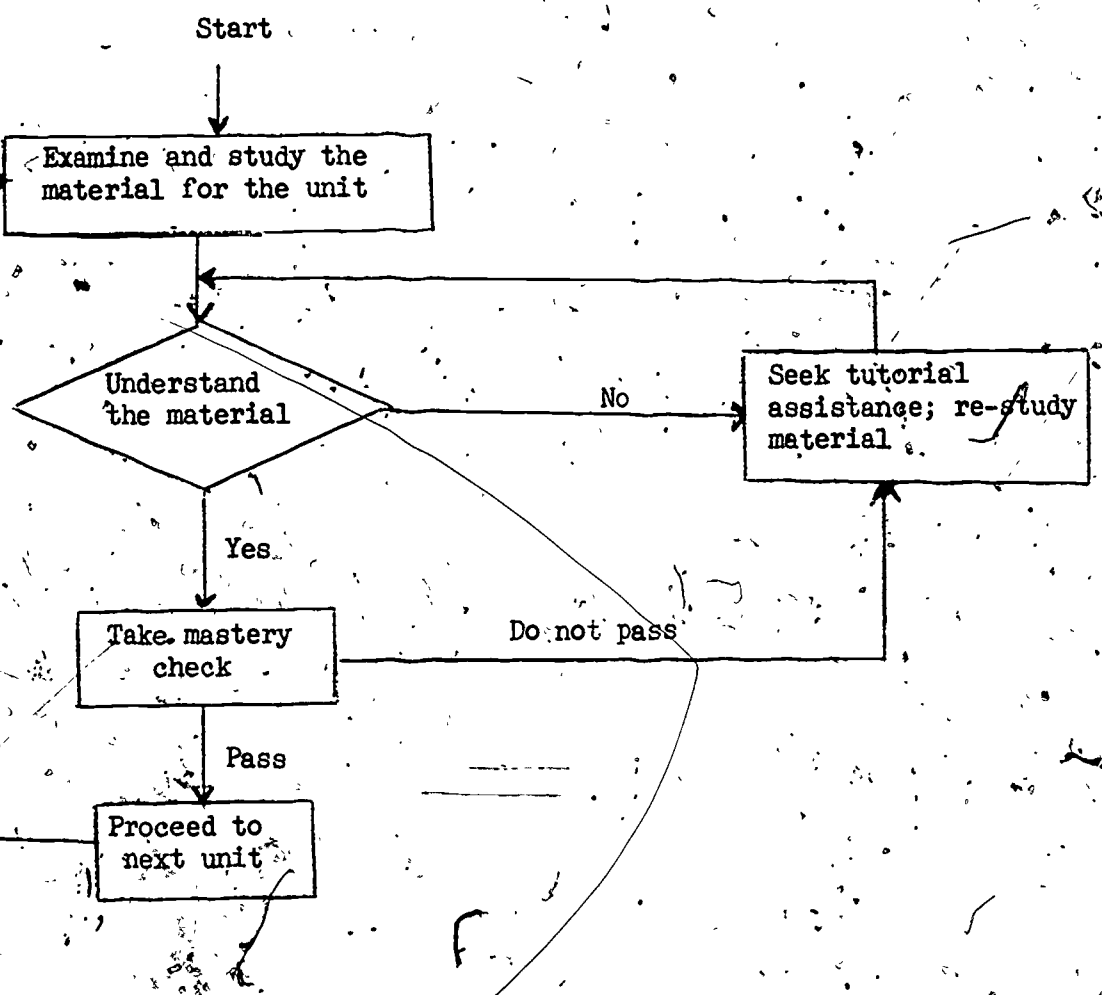
ESTABLISHING AND IMPLEMENTING THE COURSE

The variety of PSI courses probably is limited only by the number of such courses that are offered. Even our own PSI system varies according to the nature of the course each of us is teaching. We present here a PSI format that contains as its main features a system of self-pacing, student tutors, and mastery before advancement. It is patterned after the Keller Plan. The core of the instructional sequence for this particular format is presented in Figure 1.

The procedure for mastering each unit begins with the student's exposure to the material. We have discussed already the variety of materials that might be employed, but more often than not, printed materials form the major source of information for the students. The student studies the material, guided by the objectives specified for that unit. Any questions that the student cannot resolve on his own are handled in a session with a tutor. Whenever the student feels that he can fulfill the objectives specified for the unit, he can perform the mastery check. The mastery check is an examination, a paper, or some other performance in which the student's mastery of the objectives is tested. The student who passes the mastery check is permitted to proceed to the next unit. The student who does not pass the mastery check receives any tutorial assistance necessary to assist him in understanding the material. The mastery check is then performed again (normally a different version covering essentially the same material). This sequence is repeated until the student passes the mastery check.

Although this instructional sequence forms the core of our PSI format, there are several elements in its establishment and implementation that require further explanation.

Figure 1. A PSI Instructional Sequence.



Selection of Tutors: Various techniques have been employed in the selection of tutors for courses. The three major sources of tutors for an undergraduate course are: graduate students, students who have already taken the course, and students currently taking the course. Although there are some merits to the latter source of student tutors (Wilson and Tolsti, 1972: 70), we rely primarily upon students who have already completed the course. The undergraduates who have successfully passed the course at the "A" grade level appear to be just as effective as graduate students, and, in fact, often relate to the students in the course better than the graduate students.

Our selection of a tutor is based on: 1) a mastery and understanding of the material as a student in the course; 2) the ability to communicate evvectively with others; 3) evidence of maturity, reliability, and a sense of fairness; and, 4) enthusiasm for the task. We extend normal course credit to our tutors for their work. Their primary duties consist of grading mastery checks and tutoring any students who need assistance. They also perform administrative duties attendant to the course, such as administering mastery checks and making certain that all exams are accounted for at the end of the day. Since we do extend full course credit to each of our tutors, we also outline with each one an individualized course of study that extends his education in an area compatible with the content of the PSI course.

Since the quality of instruction in PSI tutorial courses depends to a large extent on the quality of the tutorial sessions, it is important to: 1) select tutors carefully, according to the criteria stated in the previous paragraph; 2) develop in the tutors an understanding of the material that goes beyond that required even at the "A" level of mastery for the course; 3) secure effective tutorial behavior designed to maximize student understanding of the material; and, 4) promote consistency and reliability in the

grading and tutoring of students. In addition to the careful selection of tutors, certain training techniques help insure the attainment of these four conditions. First, during their term as a student, tutors are socialized to the role of a tutor through their own interactions with tutors and hopefully with the instructor in his role as a tutor. Moreover, tutors receive explicit instructions from the instructor on the fine points of tutoring and grading. They also participate in tutorial workshop sessions designed to deepen their understanding of the course materials and to discuss any tutorial or grading problems that have arisen. Tutors are encouraged to seek assistance from other tutors or the instructor in the event of any uncertainty in the evaluation of student responses on the mastery check or in the explanation of material in a tutorial session. Finally, the instructor is always available to any student who feels slighted by the tutor's grading or who would prefer to obtain information or explanation directly from the instructor.

PSI instructors find that the tutors take their work seriously and interact well with the students in the course. Most students seem to be more willing to ask questions and seek help from the student-tutors than from the regular instructor. One by-product of the tutorial program is that it provides an incentive for students to master the objectives, so that they too can become tutors. Another by-product is that the tutors become a peer group of highly motivated students who enjoy interacting closely with an instructor. The tutors constitute an elite group of serious undergraduate students who are approaching a graduate school type of experience.

The number of tutors required for a given PSI course may vary with the type of course. Obviously, the lower the student/tutor ratio, the more personalized attention that can be given to each student. A ratio of approximately eight to ten students per tutor seems adequate for most courses. There

also appears to be a limit on the number of tutors that one instructor can supervise effectively. Each instructor probably needs to discover his own limit. Our experience suggests that a course which exceeds 100 students (10 tutors) is probably too large for the most effective implementation of our PSI format. This formulation is based on certain assumptions about the role of the instructor, which will be discussed in a subsequent section.

Physical Facilities: At least two rooms will be necessary for the implementation of our PSI format. One room is devoted to tutorial and grading sessions; the other room is used for the administration of mastery examinations, the most common form of mastery check. After receiving and taking the mastery exam in one room, the student takes the exam to a tutor in another room for grading and a tutorial session. The use of two rooms, as described, represents a sort of minimum essentials physical space.

Student Orientation to the Course: While not wishing to belabor the obvious, we feel compelled to note the importance of the proper orientation of the student to PSI. In our PSI course, the students meet together as a class only one time -- on the first day of class. This fact, as well as many other elements of the PSI format, may be unsettling to a number of the students, who have been socialized to function in an educational system that minimizes self-reliance and independence. Not only must students be informed of the full details concerning how the system operates and how to operate effectively within the system, but a positive mental attitude toward the course should be fostered. Consistent with the postulate that learning improves in the presence of positive conditions and consequences, students should understand the theory behind the PSI approach in order that porisive feelings about the course may be generated. Students should be encouraged to express their feelings to the instructor about the course at any time. We advise a series

or periodic consultations between each student and the instructor in order to monitor and check the academic progress and mental state of mind of the student as he moves through the course. PSI provides the instructor with the capability to engage in a much greater amount of personal interaction with each of his students than can ever be the case in more conventional lecture and discussion course formats.

The Tutorial Session: The tutorial session is the heart of our PSI format. It is here that the student receives a personalized attention to his needs and his questions. The tutorial session is a one-to-one encounter between student and tutor. Even though most tutors and instructors do not fall into the same class as Socrates, such sessions often take the form of a Socratic dialogue in which the tutor leads the student through a cognitive restructuring that promotes new insight and understanding. It is certainly a most exciting educational experience for the tutor (and instructor) to recognize that he is a teacher, in the purest and finest sense of the word.

Most tutorial sessions take place in connection with the grading of mastery checks. This is true because most students usually attempt a mastery check on the basis of their own understanding of the material and because any shortcomings in their mastery of the objectives will become apparent in the mastery check. In the grading/tutorial session, each student receives immediate feedback concerning his responses to the mastery check. Tutors are encouraged to probe the student, especially with respect to responses that may be vague, ambiguous, or unrevealing about the student's understanding of the point in question. Appropriate responses are reinforced. In the case of inappropriate responses, the tutor determines the basis for the student's response, corrects any misunderstanding or misinformation, provides any explanations required by the student, and satisfies himself that the student now understands the material

in question. This opportunity for dialogue permits the student to explain, to elaborate, and otherwise to demonstrate his mastery of the objectives. This adds a great deal of flexibility and personalization to the evaluation process.

EVALUATING STUDENT PERFORMANCE

The Mastery Check: The mastery check may take any form that permits an evaluation of the student's mastery of the performance objectives. The PSI format presented here, however, does place some constraints on the type of mastery check that can be used. Recall that three of the PSI postulates were: 1) the organization of material into several units that cover a relatively small amount of material; 2) frequent evaluation; and 3) immediate feedback. These three postulates emphasize the use of mastery checks that require relatively little time for the student to complete and that can be evaluated by the tutor in a relatively short amount of time.

Short examinations usually fulfill these criteria without necessarily confining the instructor to testing only lower level cognitive skills. Ideally, such quizzes are designed so that they can be taken in less than thirty minutes and graded very quickly by a tutor. They usually contain fill-ins, true-false, short answer, short essay, multiple choice, or certain problem-solving types of test items. The instructor should construct at least three alternative quizzes for each unit of material. Records are kept on each student that identify which form of a unit mastery check has been administered to the student and whether or not he passed it.

In addition to the mastery checks over each unit, Keller (1967: 6) recommends that review checks be conducted periodically throughout the course. These reviews may be incorporated into the mastery checks for particular units or may be administered separately. These reviews serve as an added

reinforcement to the appropriate mastery of material already covered. Reviews also promote the longer retention of what was learned earlier. Reviews may be treated just like mastery checks, requiring mastery before advancement to the next unit.

PSI instructors differ with respect to defining the term "mastery." Some require a mastery check with no errors; others permit some error, such as 90% of a unit mastery quiz. Those who achieve the prescribed mastery level are permitted to proceed to the next unit, while those who fall short must try again. The mastery level selected by the instructor is based upon the objectives, necessities, and realities of the particular course under consideration.

Pacing: Another key feature of the Keller Plan format that we have adopted is the opportunity for the student to work at his own pace in progressing through the units. In reality, however, the length of the term (semester, quarter, etc.) can establish some time constraints on the student's ability to work at his own pace. Keller (1967: 22-23) apparently operated his PSI courses under a rather liberal policy of administering "incompletes" that extended the period of time over which the student could complete all of the units. Keller's technique is more consistent with the PSI postulate of self-pacing. We have found it necessary in our courses to require students to complete the course by the end of the term or else withdraw from the course. To permit students to carry over into the course from the previous term strained our capacity to process the number of students needing to take the course.

The requirement that students complete the course by the end of the semester does tend to produce a higher rate of withdrawals from the course than in a conventional course or in a course in which a liberal policy of incompletes is adopted. Many students are unable to exercise the self-discipline necessary to pursue studies in a self-paced format. Work for a

self-paced course is often the first to be set aside while the student concentrates on the more immediate needs in his academic or personal life. Various techniques can be employed to reduce this withdrawal rate. Some PSI instructors require the student to master at least one or two units within the first two weeks of the term, so that the student will get an early start in the course. Since the first unit or two are normally easier units, this strategy also generates an early positive response and feeling toward the PSI format. It is advisable to provide a recommended schedule for unit completion to guide the student toward a successful completion of the course. Instructors also may hold conferences with students who are lagging behind in an effort to determine whether any assistance can be rendered to the student to stimulate progress in the course. Finally, additional times may be scheduled at which tutorial sessions and mastery checks are available.

Self-pacing is a powerful reinforcer in the PSE course. It probably appears more often than any other single feature in the positive evaluations of the course by the students (Kulik, Kulik, and Charmichael, 1974: 380). For most students, it is the first time that they have been able to determine for themselves how they best can use their own time, when they can study and take tests most effectively.

Course Grades: In a PSI course that requires unit mastery, two general types of course grading criteria can be identified (Wilson and Tolsti, 1972: 103). The final course grade can be based structly upon the amount of work completed. In this scheme, a grade of "A" is obtained upon the successful mastery of a given number of units. Lesser grades are based upon the completion of successively fewer numbers of units. (In a "credit"/"no credit" system, then a certain number of units are specified in order to obtain a "credit.")

The opposite of this technique is to require all students to master successfully the same number of units, and then to base the course grade on some type of graded (or "credit"/"no credit") comprehensive final evaluation. A variation of this latter technique is to use graded evaluations interspersed throughout the course (along with or even without a final comprehensive evaluation) just as in a more conventional course. Everyone still completes the same number of units, but course grades are based upon the graded evaluations.

We reject both schemes and have experimented with two other methods presented in Figure 2. In the self-paced unit mastery grading scheme, a student goes at his own pace and can obtain up to a grade of "C" strictly on the basis of the number of units completed, that is, without taking a comprehensive final. The number of units required for the "C" is based on our consideration of what constitutes the "minimum essentials" for the "C" student to know. For a grade of "B" or "A" we feel that evidence of retention and synthesis of the course material is a legitimate consideration. The comprehensive final permits a check for such evidence. Some element of risk faces the student who successfully masters the additional units, but fails to achieve the specified criteria on the comprehensive final. For example, the student who completes 15 units but scores lower than 80% on his comprehensive final receives a grade of "C". In fact, a grade of "C" also is assigned to the student who completes all of the units but scores less than 70% on the comprehensive final. In the instructor-paced non-mastery grading scheme, students complete the same number of units but are not required to "master" a munit before proceeding to another unit. The instructor sets the pace for the completion of the units. The students may take two quizzes on each unit. Only the higher of the two quiz grades is counted toward the

Figure 2. Two PSI Grading Schemes

Self-paced Mastery Grading Scheme

Grade	Requirement
E	Less than 11 units mastered
D	11 Units mastered
C	13 units mastered
B	15 units mastered + 80% on comprehensive final
A	16 units mastered + 90% on comprehensive final

Instructor-Paced Non-Mastery Grading Scheme

Grade	Requirement
E	Below 60%
D	60-69%
C	70-79%
B	80-89%
A	90% or above

Students complete all units in the course.
The unit quiz average contributes toward one half of the course grade.
Only the better of the two quiz scores is counted in the unit average.
The other half of the course grade comes from the average of three review tests.

student's quiz average. Half of the student's grade consists of his quiz average and half consists of the student's grade on three periodic review tests. Although this scheme deviates from the PSI principles of self-pacing and unit-mastery, it has worked well in our introductory empirical political inquiry course.

Role of the Instructor: The role of a PSI instructor is both demanding and different from that of a conventional teaching role. The instructor is no longer primarily a disseminator of information and evaluator of student performances. He becomes a goal setter, test constructor, prescriber, motivator, resource person, administrator, tutor -- a facilitator of learning. He participates in the course as one of the tutors, and students may come to him or any of the other tutors.

Keller (1968) does not utilize the course instructor as a tutor. He concedes the consequent lack of interaction between students and instructor as an undesirable aspect of his system. The use of the instructor as one of the tutors is a key feature for the most advantageous implementation of our format. If the course is limited to the number of students that we suggested earlier, then the instructor can interact with more students more frequently than in a conventional classroom.

The instructor also supervises the tutors and resolves any conflicts which cannot be handled by the tutors. Foremost among the concerns of the instructor is the creation and maintenance of positive conditions and consequences of student contact with course materials and tutors. Through individulalized student contact, the instructor is able to promote the student's tendency to inquire on his own and to foster in the student a favorable self-image of himself, his abilities, his creativity, and his uniqueness. For the instructor, the amount of time spent on the course

normally is equal to or greater than that spent on the conventional course. However, in the PSI course much more time is devoted to interaction with individual students and to the actual teaching of students through the tutorial session. For most instructors, this is a very rewarding experience.

EVALUATION OF PSI COURSES

Efforts at evaluating the effectiveness of PSI approaches and student receptivity to PSI have begun to appear only recently in professional publications. The evaluation of teaching techniques is quite susceptible to a variety of methodological problems (see Campbell and Stanely, 1963). The comparison between PSI and other teaching techniques is complicated further by the fact that the resource materials used in the PSI courses frequently differ from those used in other techniques. Despite these problems, however, enough evidence has been gathered to make at least some initial evaluations of PSI in general, and close variations of the Keller Plan in particular.

We are aware of two papers which have surveyed the literature for such evaluative research (Kulik, Kulik, and Charmichael, 1974: 382; Reiser, 1974). They concur in reporting a consensus that PSI students perform better on all types of examinations. PSI students also demonstrate longer retention of material than students in more conventional courses. Grade distribution in PSI courses reveal a much larger proportion of higher grades, despite controls for grading criteria. Summarizing their review of research, James Kulik and his colleagues reported that 11 of the 15 evaluative research articles they examined confirmed the superior performance of PSI students. The other four studies found no statistically significant differences between the Keller Plan and the control course. Furthermore, of the five studies judged to be especially methodologically and analytically sound, all five reported the superiority of the Keller format (Kulik, Kulik, and Charmichael, 1974;380).

Not only do PSI courses demonstrate greater effectiveness in the cognitive development of students, but student responses in the affective domain are very positive toward the PSI approach. Particularly favorable expressions are directed toward the self-pacing feature of PSI, the self-determination of study and test schedules, and the personalization aspect of interaction with the tutors and instructor (Kulik, Kulik, and Charmichael, 1974; 380). The comparison of the PSI approach to more conventional techniques invariably results in the more favorable ranking of PSI by most students.

PSI has been viewed negatively by some educators because of its perceived reliance upon Skinnerian conditioning formulations. This attitude, however, overlooks the conditioning nature of education, regardless of the type of instructional technique utilized. The undesirable conditioning effects of our educational system have been the favorite subject for many authors of popular educational philosophy books. For example, one type of behavior likely to be reinforced in a conventional lecture class is that of passivity, the student becomes dependent upon the instructor as the dispenser of information while the student is thepassive recipient. We believe that PSI can foster desirable intellectual and personal traits in students. Students in a PSI format are trained to take responsibility for their own educational development. In PSI students are challenged to think, to reason, to articulate thoughts, and to master the understanding of material much more than is likely in a more conventional setting. Tutorial sessions encourage in the students a willingness to seek out other opinions and be less defensive about their own opinions. The tutorials also enhance the development of higher cognitive skills, such as skills of analysis and evaluation.

Although we have touted highly the advantages and benefits of PSI, there are certain distinct disadvantages that diminish its effectiveness

(see Wilson and Tolsti, 1972). Certain disadvantages have been noted throughout this paper, for example: certain constraints on the use of group instructional techniques; a tendency for the number of students who drop the course to increase; and initial student apprehension about the technique. Any PSI system is a complicated one with many components that require proper implementation in order to achieve maximum effectiveness. Defects in any of these components can short-circuit the system. For example, the quality of the tutors must remain high; the construction of so many mastery checks, normally quizzes, creates problems of validity and reliability; the resource materials assume a more important role than in the conventional course; the proper physical facilities are important; and the student/tutor ratio must not exceed a certain level. Some potential PSI instructors might regard the great amount of advanced preparation for such a course as a distinct disadvantage. The preparation of multiple forms of numerous mastery exams is time consuming and may require supplies and resources that are lacking.

The potential applications of PSI have not yet been defined. Some critics argue that PSI is limited only to those courses which have a highly organized subject matter and which emphasize lower cognitive and psychomotor levels of learning. We think, however, that the PSI postulates are relevant to any kind of learning. Innovative and industrious instructors can develop PSI formats for a wide variety of courses, ranging from statistics and American government to political philosophy, from whence indidivualized instruction originated in the form of Socratic dialogues.

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