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Presentation factors as critical variables in learning by program, guide, and self study

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APPROVAL PAGE

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PRESENTATION FACTORS AS CRITICAL VARIABLES IN LEARNING BY PROGRAM, GUIDE, AND SELF STUDY

BY

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To

Mrs. W. C. (Ada) Overby

in partial fulfillment of an unselfish wish

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I. THE DEVELOPMENT OF PROGRAMING

Visionary suggestions for improving formal education are now at last becoming realities. More and better equipped plants are rising. Teachers' salaries are on the increase. More updated text books are available. Ability grouping is widely practiced. A wider range and greater depth of course offerings enhances the high school curricula. Increased alumni contributions and government grants are leading to expansion of staff and facilities at the college level. However, none of these consider how a student learns. Thus none copes directly with the most basic of needs, that of making the teaching-learning process itself more effective and efficient. The approach which at present appears to offer the best immediate solution to this problem is "programed" learning.

Though H. S. English developed and tested an automated device to establish the single habit of squeezing a rifle trigger as early as 1918, programed learning for the classroom dates back to the earliest teaching machine developed by Pressey and first exhibited in 1924. This invention was essentially a self-scoring, multiple-choice device designed both to eliminate the tedious task of scoring for the teacher and to make testing a learning experience for the student. Peterson contributed two improvements which simplified the operation and also made available a permanent record of the student's responses - first a punchboard, and later, chemically treated paper.

Teaching machines did not receive much publicity until Skinner first described his work on them in 1954. Even after this, the movement did not begin to gain momentum until a later article by Skinner appeared in 1958. Skinner saw programing's potential not only as a testing device but also as a method which could be adapted for the entire process of teaching, study, learning, and testing. He observed that in class the student passively looked, listened, took notes, and occasionally answered questions. Normal study methods appeared to consist of rather aimless reading, with only a perfunctory effort by the student to select important points, to repeat them in review, or to organize the material in outlines or condensations of notes.

Pressey's device could have been used to improve study since it called attention to important points covered in the reading material, presented questions to be answered, provided confirmation or correction, and encouraged the student to correct errors by repeated trials or by re-reading relevant portions of the study material. But there were three specific objections to this approach:

1. The total reading material formed the context and represented the background stimuli. The test stimuli required the student to recall and select for himself the information from the reading which was most relevant to the answering of the question. And since questions were not usually interspersed into the reading material, much depended upon the student's study efforts for effective use of the tests.

2. Multiple choice answers introduced conflicting stimuli which perhaps occasionally aided in forming relevant discriminations but which more often introduced irrelevant ideas which actually interfered with the learning of desired responses.

3. The long term goal of Psychologist, teacher, or executive was not sufficiently motivating to keep attention to the page at hand even though "conditioned reinforcers" such as grades or teacher approval brought the ultimate consequences closer to the study situation.

The first two objections might have been handled simply by interspersing the questions and confirmations throughout hierarchically ordered material and by requiring the student to construct his own responses from his understanding of the material. However, Skinner, in appealing to a literal interpretation of Thorndike's Law of Effect, chose to deal with the third objection in terms of conditions under which classical reinforcement is said to be most likely to increase the probability of the reoccurrence of a correct response which immediately precedes it. This concept had already given rise to instrumental conditioning procedures employed in the training of rats in the Skinner

Box, where reward is made contingent upon some overt behavior. In human learning, confirmation of a written response was said to constitute a reinforcing condition. In order to condition students' behavior most effectively it was found necessary to break the material down into very small step-wise sequences called frames. At this level of presentation, success in responding was almost guaranteed and the teaching machine provided an immediate reinforcement for the desired behavior. Thus, the first two objectives were accomplished within this framework required to meet the necessary conditions of reinforcement.

Skinner and Gilbert have summarized those principles of learning which have led a number of workers to consider seriously the development of automated teaching devices for use in the classroom. We may group programing's provisions for these variables as follows:

1. Programed instruction requires logical organization of the instructional materials and careful analysis of the educational objectives of the lesson. It also provides feedback to the teacher or lesson designer which permits him to revise and improve the materials and the presentation.

2. It allows the student to proceed at his own pace, encourages active participation, and provides feedback about his progress in the lesson.

3. It "shapes" a correct response.

Since 1958 over a dozen Skinner-type machines alone have been produced by different manufacturers. The presentation-answer-feedback cycle which characterizes Skinner's method has also appeared in the form of programed texts and scrambled books (for example, Holland and Skinner, 1961). As outgrowths of this development, hundreds of programs of varying effectiveness are available commercially for school, industry, and business; self correcting homework materials have appeared, and dozens of texts on How to Write Programs have been published.

It should be pointed out, however, that as the teaching of more complex verbal skills is attempted, programing if it remains tied to the strictest interpretation of reinforcement may be expected to become so complex that its inefficiency will begin to outweigh its effectiveness. An illustration may serve to demonstrate this contention. First, it is currently generally held that in learning involving mechanical manipulation, distributed practice is preferred over massed practice. Yet Skinner has pointed out the motivational properties of automated instruction. A "novelty" effect has been ruled out as a decisive motivating phenomenon in programing by Porter, as cited by Deese (1958), and Popham (1964). Moore and Smith (1961) have introduced evidence that massed practice with machine-programed materials has no adverse effect on retention due to the compensating AD LIBITUM feature of programing. It appears, then, that machine-programing heightens motivation in spite of itself because it incorporates an approach not common in most classrooms - self pacing. This feature is also available in other, simpler approaches, however.

Secondly, most researchers agree that the program should be carefully calibrated so that the probability of a learner's answering questions correctly should be very high, resulting in a schedule approaching 100% reinforcement. Further, Skinner and Holland have stated that even the satisfactory completion of a given number of frames constitutes a special type of partial reinforcement for college students. However, Barlow (1960), studying college students, noted rather generally that the effect of response confirmation as a reinforcer dissipated considerably and rapidly. He felt this was because it was applied too consistently. Thus Pressey and Skinner appear to be quite correct in their early predictions that "natural" reinforcers may prove insufficient and that "extrinsic" reinforcers might also have to be provided. In other words, programing is said to be effective when it <u>adds</u> variables.

In some situations it may prove quite unwieldy to add enough variables to compensate for those lost under the current concept of programing. For example, programed instruction, within the conventional limits of the term, does not appear to be ideally suited for the instruction of synthesizing behavior which involves a more complex learning than simple memorization of algebra rules or spelling words. Synthesizing behavior requires an overview of the problem to be solved, i.e., requires the student to understand how each frame relates to the other, and how all the steps fit together to form an integrated solution. Coulson (1962) observed that despite the use of preview, summary, and review frames students frequently complain that they have no clear picture of where they have been or where they are headed in the instructional sequence. External panels have been used in conjunction with programed materials in an effort to meet this problem. At various points throughout the program frames refer by number to corresponding steps in a paneled outline. The student can thus concentrate on the analysis of individual frames and can also view the frame in the perspective of the over-all solution. Panels of this nature are incorporated into an Encyclopaedia Britannica Film programed lesson on high school geometry.

Perhaps the task also requires mediated responses involving stimulus or response generalization, abstraction of information, or other rearrangement of response elements. Skinner points out the complexity of teaching these skills by machine and terms them "an extraordinary challenge to the technology of instrumentation." Finally, in view of the current literature output in all academic fields, it is difficult to imagine program production both keeping pace with the times and maintaining high quality in this area.

As the learning task becomes more involved, necessitating addition of devices to maintain effectiveness, the method of teaching by program may become inefficient in terms of cost alone due to the concept of reinforcement under which it labors. If Skinner feels the need to term programing a challenge to the technology of instrumentation, then it appears appropriate to point out to the educator that the adoption of programed methods for a county or state system is at least as great a challenge to the pocket book of the citizen who must pay the cost of machines, programs, storage facilities, and maintenance. Even now the expense of purchasing the better programed materials and apparatus is sobering.

II. THE CONCEPT OF REINFORCEMENT

There are essentially two types of studies in the literature on programed learning. One involves comparing programing with "usual" or "conventional" types of material presentation. The other investigates variables which may contribute to programing's effectiveness. Results from both are conflicting and inconclusive.

First, the relative effectiveness of programed teaching procedures in any particular learning situation has been difficult to assess with a degree of confidence because most studies have left uncontrolled one of several potentially clarifying variables. Carr (1962) in his review mentions failure to control for students' verbal abilities, pre-experimental knowledge, time allowed for study, and also for motivational influences extrinsic to the program itself. Another which appears to be of tremendous import is the selection, order, and emphasis of materials in presentation.

Second, it is to be remembered that the concept of reinforcement employed in Skinner-type programing is derived from rigidly controlled laboratory experimentation with animals, primarily with rats and pigeons. Thus any great swing to this form of programing in the classroom would appear to be based heavily upon two assumptions:

1. Knowledge of results, i.e., confirmation of the correct response, in relatively complex human verbal learning may be equated with the concept of reinforcement classically associated with animal learning. There is no evidence for this contention though it might be agreed that confirmation of correct responding may be considered reinforcing in human learning of complex verbal materials, whether or not it operates in the same way as does food reward in animals.

2. Positive reinforcement enhances verbal learning just as it contributes to an increase in mechanical skill in humans, improvement in performance of routine tasks in psychotic patients, and running or manipulatory behavior in animals. At least three hypotheses may be derived for purposes of testing whether the principles of reinforcement derived from animal experimentation are applicable to the analysis of a program's efficiency in teaching verbal material to humans.

a. Since measures of animal behavior such as frequency of correct responding and running speed are performance measures from which learning is inferred, let us speculate that performance is a reliable measure of learning in humans.

b. A 33 1/3% partial reinforcement schedule yields higher performance and an inferred higher degree of learning in humans as it does in rats.

c. Delay in reward of several minutes is associated with a learning decrement unless secondary cues effectively mediate the interval.

Little support for these hypotheses has been gained when tested by use of programs. In a pilot study for this work, college students were asked to work through a program which taught eight major products of a wholesale distributor and two reasons why each of these products was reliable. It was found that 33 1/3% partial reinforcement improved performance in terms of time taken to complete the program, as directly predictable from animal experimentation. However, it was found that post test scores for the partial group were significantly lower than those of the total reinforced group. The reason for this decrement may lie in the somewhat higher error rates per frame for the partial group or from the anxiety members of the partial group later said they had experienced while performing the task. In regard to the former interpretation Kendler (1959) calls attention to the question of transfer and cites studies on over-learning which tend to show that performance may not mirror how much has been learned, and he questions whether the completion of a programed course is the final criterion of learning even when the rate of correct responding has been high on individual frames. Whatever the underlying causes, it appears that performance was not in this instance a reliable measure of learning in humans and thus effects of various reinforcement schedules upon human learning may be difficult to predict accurately from outcome of animal experimentation.

Deese (1958) reports a study by Saltzman which shows that a delay in knowledge of results of but six seconds resulted in a 50% increase in errors on a rote verbal task. However when in the same pilot study predictions from animal experimentation regarding delay of reinforcement were tested, no difference was found between the post test scores of students working under immediate and 20-frame delayed reinforcement. The students were apparently capable of mediating this 20-frame span quite effectively. One may speculate upon what secondary reinforcers were involved. Nevertheless, there arises some question about whether immediate reinforcement, as provided by revealing the correct answers to the student following his written response, actually leads to increased learning. Perhaps certain types of subject matter and certain types of learning might be able to withstand fairly long delays without affecting learning rate appreciably.

It may be seen that these are merely demonstrations of Amsel's 1959 contention that variables which produce sustained higher performance rates on programed materials may have no effect whatsoever upon learning.

At the heart of the difference between the Skinner and Crowder methods of programing is this fundamental theoretical controversy. Basically, Skinner maintains that learning takes place most effectively when a correct response is made and immediately reinforced. Crowder, on the other hand, asserts that learning can effectively take place while the student is reading the information presented, and that the multiple-choice testing at the bottom of the page is primarily a confirmation of the learning that has already taken place. Two recent studies provide rather striking evidence in support of Crowder's position. Goldbeck (1960) compared test scores of grade school students who gave written responses, thought responses, and no responses. In the latter group the answers were filled in and underlined. Although raw scores for the immediately reinforced, written response group were slightly higher for easy material, no significant differences in terms of efficiency (post test score/time) were found between the groups. Ripple (1963) compared the effectiveness of a programed text with three other methods of presentation: standard programed text without reinforced feedback, conventional text form, and listening to a lecture. It was found that reinforcement did not contribute to increased learning, retention measured at two and ten days was not improved, and individual differences were not reduced. Active involvement however did contribute to increased learning (1963). Cronbach (1964) cites six studies performed since 1960 which show that reading a programed text produces as much learning as does making active responses to the program and that reading accomplishes the same result in less time.

Glaser (1960) in his evaluation of programing, re-emphasizes Skinner's concern with three other variables thus far not discussed: selection and ordering of material, definition of the learner population and specific learning goals, and feedback to the writer on effectiveness. Carr (1962) in his review also expresses the opinion that the usefulness of teaching devices is more a function of characteristics of the program itself than a function of characteristics of the device. There is support for this feeling even when considering a very elementary skill. For example, three experiments are reported by Moore and Smith (1961) in which sixth grade classes learned spelling words with the aid of machine programs giving knowledge of results in various ways or giving no knowledge of results. Since no significant differences in learning were noted between the groups it was concluded that providing Ss with knowledge of the correct response did not facilitate his learning of spelling. They maintained that the effectiveness of self-instructional materials in spelling found earlier by Porter may be attributed to the format of the material rather than to the use of a technique for providing immediate knowledge of results.

Indeed it now appears altogether conceivable that a number of the earlier studies showing the relative effectiveness of programing over conventional teaching of verbal material achieved such results because they in effect pitted an unskilled programer, i.e., the teacher, against a programer skilled in developing effective presentations. Among the studies where this variable has been controlled by using the identical format in all conditions, not one has been located which defines "usual" or "conventional" approaches as any other than a passive listening, watching, note-taking, or reading process on the part of the student. Even if outside study were permitted in these investigations, normal study methods often consist of rather aimless reading, with only perfunctory effort to select important points, to repeat them in review, or to organize the material in outlines or notes.

Thus, comments which might be made regarding the collection of studies which apparently support programing over classical teaching techniques are not unlike those offered by Holt (1958) concerning evidence compiled by Meehl (1954) as support for Actuarial over Clinical prediction:

1. It would appear that in both instances the deck has been accidentally stacked by pitting a sophisticate against the non-sophisticates.

2. In both cases the non-sophisticates may be found lacking in areas where they should become competent if they wish to improve the batting average.

3. And in both situations, the basic models are upheld, i.e., the new approach is not to be heralded as a revolution replacing the classical approach but rather as a forceful hint that the older techniques need a bit of shaping up.

III. EFFECTIVE STUDY

Perhaps programing is meeting the immediate needs in selected areas. But it appears that reading, listening to lectures, and studying outside of class are still very much with us on all levels of education and will continue to be required. Thus if one is conscientiously seeking a realistic approach to meeting the long term needs of education on the broadest possible scope, then it must be apparent that an approach is needed which fits the existing educational structure and is not so rigidly bound to the concept of 100% immediate reinforcement of responses which are guaranteed to be correct because of presentation in sequences involving the smallest possible steps.

Programing clearly demonstrates the value of defining learning goals in light of the specific learner population, of selecting and ordering materials, receiving feedback, and revising. There is no reason why, after participation in a workshop, a lesson designer could not apply these principles, nor any reason why a teacher could not practice these in her class. The same plan of action suggested by Hughes for Construction of an Academic Program for School Consultants in Programed Learning (1964) might be followed for training consultants to schools merely in the area of effective selection, ordering, and emphasis of material for presentation to students by print or lecture. Further, if pressure were exerted upon authors and publishers, there would shortly be available quantities of text books revised with emphasis upon logical ordering rather than upon the unstructured cramming of facts by chapters between the covers. Perhaps adapting a modification of the RULEG system for the construction of verbal learning sequences would be helpful in this connection. However, though informed of learning goals and provided with structured texts and class presentations, the student may still remain at a loss as to how to proceed in some situations. Though perhaps disguised from a learner, working through a program is one way of effectively studying material. Further, since effective study in any form is essentially a learning process, it would be desirable to retain the relevant learning variables present in programed instruction in setting up any study procedure.

Much effort is currently being expended on informing students how to study. High schools frequently distribute booklets to assist the student in formulating general study habits and in preparing for specific courses (for example, How to Study, John Marshall High School, Richmond, Virginia). Many colleges and universities provide special non-credit courses or clinics designed to improve reading skills and study habits. Frequently these courses concentrate upon increasing the student's perception of ideas from the printed page. The student learns to generate questions before he reads. He practices reading for a specific purpose and is taught ways of checking his comprehension upon completing his reading. He is encouraged to note important terms, rules, and examples, to systematically review them, and to continually self-check his learning progress. In the method taught and examples given, most of Skinner's variables are retained. Unfortunately, few at present can take advantage of the various techniques including tachistoscopic training, pacers, timed reading and written exercises, which are used in the clinics to increase efficiency in perceiving. And, of course, when reading conventional texts, parallel, or journals one can not benefit from the extensive cuing techniques employed in programed materials. However, adding meaningful examples and retaining minimal selective cuing in the material itself in addition to having the student generate his own cues and benefit from "feedback" should make up for these deficits. Extrinsic motivators should exert a continuing effect as in programing. Moreover, retention may actually be enhanced by self study because several opportunities seem available for deriving meaningfulness which are not as readily utilized when learning from a program due to the very nature of the difference in the way information is arranged on the page:

1. Inspection of the material in its entirety before study should give a general orientation to the subject matter which may be valuable in organizing and remembering numerous details.

2. Those points upon which one finds himself weak may be reviewed whenever and as often as desired. The student can self-check his own learning to determine what areas need further study if appropriate guide lines are provided.

3. Flexibility allows the use of more meaningful examples and illustrations based upon the backgrounds of the particular students involved.

4. The more natural reading situation allows one to change pace whenever practical. Easy or familiar material may be skimmed; difficult or unfamiliar information may be scrutinized with more care.

5. Synthesization, abstraction, and original thinking are possible as is the achievement of goals beyond those desired by the teacher or programer.

6. Comparing and relating information to one's own previous experience and to other materials is encouraged.

7. With all the new concepts visible at once or easily located, even subtle discriminations may be formed which may otherwise have gone unnoticed or remained sources of confusion.

8. Material may be more easily referenced, indexed, compared, and skimmed; the necessity of tediously plowing through many frames to locate one single item of interest is eliminated.

The indication is that with well presented material some form of structured self-study may be equally as effective and efficient an approach to learning as programing with certain types of tasks, and perhaps even more efficient in terms of training time and cost, with tasks requiring skills in addition to rote memorization. To the knowledge of this writer there has not appeared i[illegible]iterature an adequate test of this contention.

The major purpose of this study is to make an initial attempt at comparing the effectiveness and the efficiency of studying through use of a program, study guide, and individual procedures.

METHOD

Forty-eight male college students, who were enrolled in the Introductory Psychology classes at the University of Richmond, served as Ss. All Ss had passed Freshmen Mathematics with a grade of C or better. None had a checking account in a local bank, and none had taken a course in Logic of any type.

Assignment of Ss to twelve groups was based upon verbal scores attained on the College Aptitude Test required for admission to the University. Group means and standard deviations are reported in Table 1. F max $(3, 12)_{obs} = 27.01$, performed to test the assumption of no differences with respect to homogeneity of variance, was not significant at the .95 level of confidence.

Half of the Ss participated as volunteers, a condition labeled as Intrinsic Motivation. Participation for the others was made a course requirement to give conditions of Extrinsic Motivation. Each S turned in to E a list of times when he was free to participate in the project. From this list, Ss under volunteer conditions were allowed to choose

Table 1. Means and Standard Deviations of Verbal Ability Scores for Twelve Experimental Groups.

Group	Mean	SD
Ex. - Logic - Program	490	114
Ex. - Logic - Guide	490	64
Ex. - Logic - Self	490	82
Ex. - Bank - Program	491	132
Ex. - Bank - Guide	489	98
Ex. - Bank - Self	491	129
In. - Logic - Program	492	62
In. - Logic - Guide	495	149
In. - Logic - Self	490	105
In. - Bank - Program	492	29
In. - Bank - Guide	491=	108
In. - Bank - Self	490	61

$F_{max\ obs.} = 27.01 < F_{max.95(12,3)} = 44.60$

a time most convenient to come to the laboratory. Ss under the compulsory conditions were assigned times by the E. Further, classes from which volunteers were solicited were given only general reminders concerning their obligation. If these Ss failed to meet their appointment, they were allowed to escape the task. On the other hand, each S participating under the required conditions was contacted by phone, letter and by personal contact in class until he completed his obligation.

Each S was presented one of three sets of working materials:

1. Program. Two booklets of frames were used. Each required written responses and was accompanied by a scrambled answer sheet against which responses to each frame were compared with minimal delay (Appendix A).

2. Study Guide. Information was lifted directly from the program and set in conventional text reading style. Minimal selective cuing was retained. No responses were required. The material was prefaced by a guide, outlining a method of study based upon all learning variables intrinsic to programing with two exceptions : the more general idea of feedback was substituted for the concept of 100% reinforcement, and a specific statement of purpose was added. (Appendix B)

3. Self Study. The same typewritten information as in condition 2 above was used. Instructions were given

to study the material in whatever way was customary for the individual. (Appendix C).

Two different contents were used. One, which described how several kinds of checking accounts operated, was termed easy. The second, which introduced basic symbolic logic was considered difficult by comparison in terms of content and size of steps. The program for the easy material was obtained from Psychological Consultants, Inc., Richmond, Va. The program for difficult material was available commercially. Both met the usual criteria for effectiveness[1] and were thus assumed to be adequate for the purposes of comparison in this study.

As the Ss worked individually in isolated rooms, time measures were taken for reading instructions as well as for actual working time. When the S had completed reading and studying the material, the first post-test was administered. Items required response construction, sentence completion, and True-False choices. Approximately one-half of the forty point power post-test measured the S's knowledge of the material. The second half measured how well the S could use the

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1. These criteria, summarized by Vanderschmidt (1964) include: statement of prerequisite knowledge, statement of terminal objectives, pre-test and post-test with analysis of pre-test data, description of test population, statement of error rate, suggestion for program administration, statement of average time required to complete the program, and a measure of student attitude.

material in giving practical examples and solving problems (Appendices D and E).

Efficiency measures were computed by dividing the post test score by the total time taken to complete the task (excluding time taken to complete the post test).

Exactly one week later the same post test was presented in slightly different format and with items rearranged. Ss had no exposure to the material during the week and had been asked to cooperate by not discussing content with other students. The differences between scores attained on first and second tests were taken as Retention measures. After a fifteen minute review using original working materials, Ss were given the third post test consisting of the same items again rearranged and placed in different format. Difference scores between second and third tests were taken as measures of relearning.

Analysis was accomplished by means of separate Analyses of Variance (non-repeated measures) for Initial Learning, Efficiency, Retention, and Relearning. The .05 level of significance was maintained throughout analysis of all main effects and simple effects. Duncan tables for assessing differences between means were used for A POSTERIORI testing.

RESULTS

An Fmax (.05) performed on the scores supported the hypothesis of no difference with respect to homogeneity of error variance, thereby indicating that the basic underlying assumption required to perform an ANOV had been met. Analysis of Variance was performed to assess differences with respect to initial learning. The findings are summarized in Table 2. Differences due to main effects were not significant at the .05 confidence level. This finding was interpreted as support for the hypothesis that an equal degree of learning over both easy and difficult materials may be achieved through use of Program, Study Guide, and Self Study procedures.

Efficiency scores were derived by dividing initial learning scores by total time taken to complete the task (excluding time taken to complete the post test itself). A preliminary test of the hypothesis of no difference with respect to homogeneity of error variance was performed by means of Hartley's Fmax. The hypothesis was confirmed at the .05 level of significance. As shown in Table 3, differences in Efficiency due to Presentation were found to be significant at the .05 confidence level and to exceed the .01 level. Marginal means for

Table 2. Summary of Analysis of Variance: Initial Learning.

Source	df	MS	F
A	2	188.08	3.17
B	1	0.75	0.01
C	1	16.33	0.28
AB	2	36.75	0.62
AC	2	31.58	0.53
BC	1	225.33	3.80
ABC	2	36.58	0.62
within cell	36	59.32	----

Table 3. Summary of Main and Simple Effects: Efficiency.

Table 1. Summary of Analysis of Variance: Efficiency.

Source		df	MS	F
Presentation	A	2	2783.08	5.73**
Difficulty	B	1	2992.52	6.16*
Motivation	C	1	13.02	0.00
	AB	2	591.08	1.20
	AC	2	1196.08	2.45
	BC	1	1485.19	3.06
	ABC	2	1257.75	2.59
Within cell		36	485.90	----

*= .05 sig.

**= .01 sig.

Table 11. Summary of Duncan Test on Pairs of Ordered Marginal Means: Presentation.

Ordered means: 41.56 58.94 67.44

Ordered differences:	$a_{prog.}$	a_{self}	a_{guide}
$a_{prog.}$	--	17.38*	25.88*
a_{self}	--	--	8.50

the Programed group, tested at the .05 level, were noted to be significantly lower than those of both Guide and Self groups. Scores for Guide and Self groups did not differ at the .05 level. These findings support the hypothesis that learning by program, at least on the college level, is less efficient than learning by guided or self study.

Efficiency scores were observed to be significantly higher at the .05 level for easy material than for difficult material. Since learning scores did not differ, this finding appears to be merely a reflection of the relative lengths of the two sets of materials.

It may be noted also from Table 3 that no difference at the .05 level was found in efficiency between the main effects of the two motivational variables.

A non-significant Fmax allowed performance of Analysis of Variance on differences between scores for first and second post tests and on differences between scores for second and third tests. The findings are summarized in Table 4. No difference approached significance at the .05 level of confidence. Retention and relearning were evidently not affected by differences in presentation, difficulty, or motivation.

Table 4. Summary of Main Effects: Retention and Relearning.

Table iii. Summary of Analysis of Variance: Retention.

Source		df	MS	F
Presentation	A	2	31.02	0.--
Difficulty	B	1	7.52	0.--
Motivation	C	1	256 .69	2.90
	AB	2	38.02	0.--
	AC	2	1.69	0.--
	BC	1	5.68	0.--
	ABC	2	33.94	0.--
within cell		36	86.28	--

Table iv. Summary of Analysis of Variance: relearning.

A	2	41.33	1.44
B	1	6.75	.23
C	1	6.75	.23
AB	2	49.00	1.70
AC	2	9.00	31
BC	1	108.00	3.75
ABC	2	3.00	.10
WITHIN CELL	36	28.76	--

DISCUSSION

The primary hypothesis tested here was that attention to material preparation is the primary factor distinguishing programing from the "usual" or "conventional" teaching methods. In other words, if presented materials selected and organized as well as those of the more effective programs and provided with cuing sufficient to give general orientation to study, students will achieve significant increases in performance equivalent to those gained through the entire process of programing. A general overview of the data reveals three findings which appear to support this hypothesis.

Inspection of the working materials confirmed that Ss under the Guide condition attended the statement of purpose and followed faithfully the instructions to note critical information, underline selectively, summarize and review. However, it was found that this procedure did not enhance initial learning, efficiency, retention, or relearning over that of the Self Study procedure. This would seem to indicate that directedness of study, mechanical manipulations, and addition of personal cues are relatively unimportant factors.

Performance was equal or better for Self and Guide groups than it was for the Programed group on all measures. This would appear to be further evidence that segmented presentation, overt responding, assured correct responding, and immediate feedback are factors also relatively unimportant.

Though an equal degree of learning over both easy and difficult materials was brought about through use of a Program, Study Guide, or Self Study procedure, the latter two procedures appeared to be more efficient in terms of study time.

The fact that the hypothesis appears to find support in this study but not in others may be accounted for in one of at least three ways. Further research is needed to determine which explanation is most applicable.

In this study, an attempt was made to control three variables which may have confounded the results of previous studies. Ss were used who had had previous opportunity to develop good individual study habits. Groups were matched for verbal ability. Presentations were matched for content, order and minimal selective cuing. When these conditions exist, it may be that a programing technique is no more effective than guided or self study procedures and is actually less efficient in terms of training time and costs.

Findings cited by Hershberger (1965a) and Mager (1964) provide background for a second possible explanation. In the former study, it was found that eighth grade students achieved higher learning scores on "core" material in the presence of very mominal typographical cuing. However, this age group either could not or was not willing to learn to focus its attention as selectively as required under conditions of more extensive cuing. Further, gains were noted under learning conditions comparable to the guide condition in this study over the self condition, possibly because study skills were not sufficiently well developed by the eighth grade. In the latter review, course objectives were stated in advance, but adult students controlled the learning experience entirely. Findings showed a 65% decrease in training time, variations in content sequencing, an increase in student competence and confidence, and achievement comparable to that noted under the more highly structured conditions of programing and lecture methods used previously. Apparently, allowing relatively more freedom for the student yielded reduced training time because students used knowledge gained through previous experience to advantage more efficiently than did the "experts" in mapping out individual study procedure.

One implication from these two studies is that the amount of structure and control of study procedures <u>required</u> to promote effective learning decreases with education, or study skill development, and experience. The college population, from which Ss were drawn for the present experiment, is about at the midpoint of the three populations sampled in these studies with respect to education and experience.

Thus, rather than aiding the learner, it appears that excessive structure could conceivably have conflicted with college students' well established study habits. This would account for the relatively inefficiency of the programed method.

Finally, the results may be merely an artifact. This would be true if a major portion of the potential learning curve was left unsampled, ie., if the "difficult" task was not sufficiently demanding for college students. It is the purpose of programing to start the learner at his own level of knowledge and to present information in such a way that is is easily understood, learned, and retained. Thus the difficulty of a programed task must be measured by size of presentation steps rather than by content. However, the difficulty of a textbook presentation may be measured in terms of content since presentation steps are merged. Thus units of Physics, The Calculus, or Organic Chemistry are suggested for use in future research to provide sufficient contrast and a more adequate sampling of the potential learning curve.

The following discussion concerns the conspicuous absence of findings related to three secondary hypotheses. The meanings of these non-significances need clarification by further research.

Contrary to expectation, an extrinsically motivating condition failed, on all measures, to enhance performance on any of the three presentation conditions. Scores under these conditions, though not significantly different, tended to be lower than those under intrinsic conditions.

Professors of intrinsically motivated classes exerted no pressure on their students, whereas the professor of the extrinsically motivated class inforced the requirement without exception. Thus, it seems safe to assume that Ss were successfully duped into believing that hhe conditions under which they participated were valid. Postulating the non-existence of an effective motivating condition would therefore apparently not be adequate to account for the finding of no difference.

Rather, the presence of both a positive and negative attraction to the task under the required condition to nullify any effect expected by an extrinsic motivator. In other words, Ss were motivated to complete the task to meet class requirements but were repulsed by the demand itself and thus did not give full cooperation. The latter attitude was evidenced by the necessity of having to contact more than half of this group two or more times.

Skinner, as cited earlier, hypothesized that incentives such as grades and meeting teacher approval would serve to keep the student at his task. The condition of "meeting course requirements" was chosen for this study as an approximation of Skinner's suggestions. Apparently, the existance of the requirement was indeed sufficient incentive under all presentation conditions to keep disinterested "drafted" students at their task. However performance under this condition matched, but did not exceed, performance under the volunteer condition. From these results it would that equal gains in learning may be evidenced in the classroom either by capturing the interests of the students or by forcing them to meet class requirements. The question of "what extrinsic conditions are effective in elevating group performance above that found under presently employed methods" remains unanswered and must be dealt with in future research.

The student's abilities to retain information and to relearn efficiently surely are factors which play as important a part in his earning a good final exam score as his abilities to understand and learn initially. Retention has been a grossly neglected measure in studies which purport to deal with the effectiveness of various teaching methods. Yet the "take home" value of a course lies not in what was at one time at hand and understood, but, rather, in what the student can continue to use after the course has been completed.

No difference was found in this study with respect to retention. However, the time lapse of one week was hardly a sufficient interval from which to estimate extinction which may occur over the course of a quarter or a semester. Extinction measures have been found to be of great value in investigating the learning of animals. There is every reason to believe that they will prove useful in future efforts aimed towards gaining a better understanding of verbal learning.

The outcome of no difference with respect to relearning was also unexpected because it was felt that locating numerous specific points rapidly from a program would prove to be a difficult task, but that personalized cuing as provided in the guide condition would facilitate this process. A shorter criterion time would not be expected to produce differences since in the time allotted for review no subject attained a perfect score, ie., no ceiling was placed on achievement. It seems more likely that the extent of cuing retained in the rewriting of the programs in conventional text styles facilitated self study groups' finding material readily. Further, it is evident that the type of programing used was not as fair a representation of complex segmentation of information as would have been a scramble book, machine, or a much longer and unindexed program.

SUMMARY

Forty-eight male sophomore college students, with no preknowledge of checking accounts or logic, were divided into twelve equal groups, matched for verbal ability. Initial learning, efficiency, retention, and relearning measures were taken across programed, study guide, and self study presentations, with content, order, and minimal cuing constant, for easy and difficult material. On tests twenty points were assigned to rote memory and twenty points to applied knowledge. No differences were found with respect to initial learning, retention, and relearning. Programing was found to be inferior to the other two methods of presentation in terms of efficiency. Three alternative means of accounting for these results were offered.

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VITA

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