

DESIGN AND EVALUATION OF A PROGRAMMED COURSE IN INTRODUCTORY PSYCHOLOGY¹

W. C. SHEPPARD AND H. G. MACDERMOT

UNIVERSITY OF OREGON

The design of a programmed course in introductory psychology, utilizing an interview procedure, is described. The performance of students in this course was compared with that of students covering the same subject matter but taught in a more conventional manner. Students in the experimental course scored significantly higher on objective and essay final examinations and rated the course more positively.

A technology of teaching (Skinner, 1968; Keller, 1969) is being developed, utilizing principles derived from an experimental analysis of behavior. The technology has been applied at the university level, most appropriately, to teach courses in the experimental analysis of behavior (Ferster, 1968; Keller, 1967*a, b*; Kent, 1965; Lloyd and Knutzen, 1969; Malott, 1968). This report describes the design and evaluation of a programmed teaching procedure applied to a large undergraduate course in the psychology of learning. The design of this experimental teaching procedure was patterned after the approach taken by Keller (1968) and elaborated by Ferster (1968). The performance of students taught using this experimental teaching procedure was compared with the performance of students covering the same subject matter but taught in a more conventional manner (see also McMichael and Corey, 1969).

METHOD

Subjects

Students registered for an introductory course entitled Psychology of Learning without prior knowledge that they would be involved in an experimental program. A total of

301 students enrolled and were assigned to either of two groups based on the first initial of their last name. Two hundred and three students, whose last names began with the letters A through O, were assigned to the section using the experimental teaching procedure; 98 students, whose last names began with the letters P through Z, constituted the conventional instruction, or control group.

Procedure

The fundamental feature of the experimental teaching procedure was the interview. The interview involved an interaction between two persons. A student participated in an interview as a speaker after studying a small section of the assigned text, typically five to 15 pages. The listener in the interview was, at various times, the course instructor, a teaching assistant, or, most often, another student who had previously studied and successfully passed an interview on that section of the text. During the interview, the speaker was required to describe fluently and in detail to the listener the material contained in that section of the text within a 10-min period. The listener attended to the speaker without interruption, took notes on his performance and timed him. Both the speaker and listener were permitted to refer to the text or notes during the interview. After the speaker stopped speaking, the listener had the responsibility for asking questions to probe an omission or inaccuracy, comment upon the speaker's performance, and engage the speaker in a discussion of some aspect or implication of the section.

The decision as to whether the speaker's performance was satisfactory or not was jointly

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determined by both the speaker and listener. If both the speaker and listener were satisfied that the speaker's performance demonstrated mastery of the section, they recorded the fact on an individual progress chart, which the listener signed.

On those occasions when a speaker's performance was judged to be not satisfactory, which was usually self-evident because of difficulties the speaker would have in completing the interview within the allotted time period, the listener and speaker discussed those difficulties. The speaker then restudied the same material for at least 10 min before repeating the interview. When the repeated interview was successfully completed, which could involve more than one repetition, the fact was recorded and the student continued without any penalty.

Each student was required to serve alternately as a speaker or listener a designated number of times during the course. This number was determined by the grade the student wished to earn. An additional requirement was that for every student, a teaching assistant serve as a listener on the average of once every five interviews. After completing three to five interviews, a chapter or two, the student took a written exercise, lasting approximately 20 min, that consisted of four or five short-answer essay questions. The essay questions were randomly selected from either a list of study questions that had previously been given to the student or from questions included at the end of each section of the text.

A teaching assistant read the answers, discussed them with the student, and made a decision as to whether the student's performance on the written exercise was satisfactory or not. A satisfactory performance required that all responses be functionally correct. If they were, the student continued on to the next assignment; if they were not, the student and teaching assistant jointly determined where errors existed, the student then reviewed the material for at least 10 min and took an alternative form of the same exercise. There was no penalty for repetition of a written exercise.

The course content consisted of the text, *Behavioral Principles*, written by Ferster and Perrott (1968). The text covered in depth the principles of respondent and operant conditioning. The text was divided into 36 sections;

each section comprised the material to be covered in a single interview. The student's grade in the course was determined by how far he progressed through the material. To earn a grade of "A", the student was required to complete successfully 36 interviews and 11 written exercises. To earn a "B" in the course required completion of approximately three-fourths of the material needed for an "A"; coverage of approximately one-half of the material necessary for an "A" earned the student a grade of "C", and a "D" grade required coverage of approximately one-third of the amount necessary for an "A". There were no penalties imposed for repeating either interviews or written exercises.

The three-credit hour course met for 1 hr three times a week for nine weeks. During the class period, students either studied the text, participated in interviews as a speaker or as a listener, or were engaged in answering the essay questions that comprised the written exercise. In addition to the regularly scheduled class period, students could participate in these same activities in a small classroom staffed by at least two teaching assistants from 12 P.M. to 5 P.M. each weekday. This provided a total of 45 class days during the term.

The students were assigned to one of 12 teaching assistants who were upperclass undergraduate students who had covered the material using the interview procedure under the supervision of the course instructor. The teaching assistants received 3 hr of academic credit for performing their duties. The teaching assistants certified student progress by recording the results of interviews and written exercises as they were completed, listened to interviews, selected questions for the written exercises, discussed the material with students and met weekly as a group with the instructor to analyze the course. The instructor organized the course, observed the class procedures, listened to occasional interviews, held individual discussions, and met with students having special problems.

Three lectures were presented during the term by the course instructor, attendance at which was optional.

The procedures followed with the conventional instruction, or control group, were designed to make the two groups as comparable as possible in respect to the amount of time students from each group spent speaking, lis-

tening, writing, and conversing with the teaching assistants or the instructor.

Students placed in the control group were assigned the same text as the experimental group. They were required to meet weekly for one 2-hr period to take part in small (five to 10 person) group discussions, and to meet once a week for an hour as a class with the instructor or a teaching assistant. Specific sections of the text were assigned to be covered during the small group-discussion meetings. The same study questions provided to the experimental group were given to the control group. The weekly class hour was devoted to a question and answer period. In addition, each student in this group was required to write a short, one to two page, paper every other week on some aspect of the material being covered in the text at that time.

The same three lectures made available to the experimental group were also presented to the control group; again attendance was optional. The teaching assistants and course instructor were the same for the experimental and conventional groups.

The students in both the experimental and conventional instruction groups were given the same objective final examination at the end of the course, consisting of 100 multiple-choice questions with each section of the text being equally represented. In addition, there was an essay examination consisting of five questions. Since a high level of student performance was anticipated, both the multiple choice and essay questions were designed by the course instructor to be more difficult than any similar examination questions he had ever given to undergraduate students before.

Students in the experimental group were told that the purpose of the final examination was not to determine grades but rather to ascertain the effectiveness of the procedures used in the course in helping them to master the course material. Students in the control group were told that 50% of their final grade in the course would be determined by their performance on the final examination. These instructions might be expected to bias performance on the final examination strongly in favor of the control group.

Immediately before the final examination, both groups were asked to complete an unsigned attitude survey in connection with the course.

RESULTS

Of the 203 students assigned to the experimental group, 168 remained after the first three weeks, the university "drop" period. Fifty-five of these students progressed to the "A" level, 58 completed the work necessary to earn a "B", 51 earned a grade of "C", only two students received "D" grades, and two failed the course.

Figure 1 shows that students in the experimental group progressed through the material at different rates. In general, students earning A's completed the first interview earlier and progressed at a more rapid rate than those students earning B's; students earning B's started before those earning C's and also progressed at a more rapid rate.

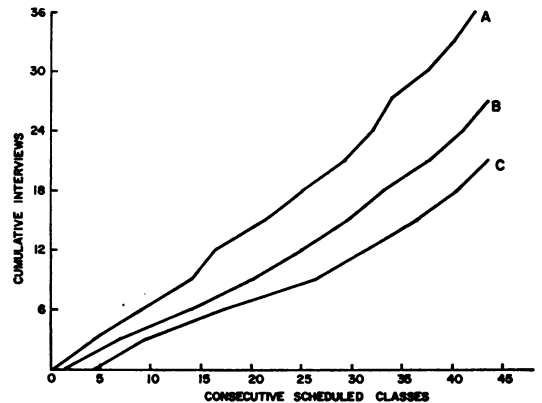


Fig. 1. Cumulative curves of mean completed interviews as the term progressed for students earning "A's", "B's", and "C's" in the experimental course.

Six per cent of all interviews were judged to be unsatisfactory and were repeated once; less than 1% of all interviews were repeated more than once. Students serving as listeners were just as likely as teaching assistants to judge an interview unsatisfactory.

Attendance during the class periods varied from approximately 40 to 70%. Many students were able to complete the interviews and written exercises required for an "A" during the regularly scheduled class periods. Other students preferred to take advantage of the times teaching assistants were available in the small classroom and consequently did not attend the regularly scheduled class. Several students were able to complete the course at the "A" level within six weeks and a large number of students had reached this level before

the end of the nine-week period. Upon reaching the "A" level, students were excused from further class participation.

In the control group, 92 of the original 98 students were still enrolled after the first three weeks of the term. Thirty-five of 203 students dropped from the experimental group as compared to six of 98 from the control group. Was it possible that any differences in performance between the experimental and control groups could, perhaps, be accounted for by poorer students dropping the experimental section? In order to examine this question, the cumulative grade-point average of each student was obtained. The average grade point for all of the students remaining in the experimental group was 2.72, the average for those remaining in the conventional group was 2.69, and the grade point average for those students who dropped the experimental section was 2.67. Since the GPAs of these groups are extremely similar, the possibility that differences in performance between students in the two groups could be accounted for by a bias introduced by students dropping the course is highly unlikely.

On the 100-question objective final examination, the mean score for the experimental group was 73.1 with a standard deviation of 12.1, and the mean score for the control group was 66.8 with a standard deviation of 11.9. The difference between means is significant, using a *t* test, beyond the 0.01 level of confidence. The Kuder-Richardson estimate of reliability for the objective final examination was 0.89.

Since the students in the experimental group had already earned their grade, based upon the number of interviews and written exercises they completed, it is possible to compare their scores on the objective final examination as a function of the amount of course material completed. Those students who completed the material necessary to obtain an "A" averaged 82.5 on the objective final examination; the students who progressed to the "B" level averaged 71.7; those who progressed to the "C" level averaged 65.3; and those who progressed to the "D" level averaged 52.5. The performance of students in the experimental group is directly related to the amount of material they had covered.

A five-question essay examination was also used as an evaluative instrument to determine

whether there was a difference between the two groups in their ability to verbalize the course material. Three readers independently scored the essay examinations from both the experimental and control groups using a 25-point scale. The names on the examinations were covered so that the readers did not know to which group each examination belonged. The reliability of the scores assigned to the essay examinations by the three readers was as follows: between readers one and two there was a reliability of 0.92; reliability between readers one and three was 0.78; and reliability between readers two and three was 0.83. The average scorer reliability was 0.85.

On the essay examination, the mean score for the experimental group was 17.4, with a standard deviation of 5.9, and the mean score for the control group was 13.9, with a standard deviation of 6.5. The difference between means is significant, using a *t* test, beyond the 0.01 level of confidence. Again it is possible to compare the scores of the students in the experimental group on the essay final examination as a function of the amount of course material completed. Those students who completed the material necessary to obtain an "A" averaged 21.3 on the essay final examination; the students who progressed to the "B" level averaged 17.0; those who progressed to the "C" level averaged 14.4, and those who progressed to the "D" level averaged 6.0. The performance of students in the experimental group on the essay final examination is directly related to the amount of material they had covered.

Single measures of student satisfaction with the experimental teaching procedure and the conventional instruction procedure were obtained from a weighted composite of the student ratings on the following three items, which were part of the attitude survey both groups were asked to complete:

1. How satisfied are you at the present time with this course? Nine-point scale ranging from extremely satisfied to extremely dissatisfied.
2. What is your reaction to the manner in which this course was taught? Seven-point scale ranging from very delighted to very disappointed.
3. How does the probable long-range value for you of this course compare with

all other courses you have had in college? Five-point scale ranging from highest 10% of other courses to lowest 10% of other courses.

The composite measure of student satisfaction for the experimental teaching procedure was significantly higher ($P < 0.01$), using a *t* test, than the conventional instruction procedure.

The correlation between the composite measure of student satisfaction for each student and the achievement as measured by each student's score on the objective final examination was $r = 0.46$ for the experimental group and $r = 0.30$ for the control group.

In response to the question, how effective was the interview method in helping you to master more material in greater depth in comparison with the traditional lecture-examination method?, 94% of the students in the experimental group rated the interview method more effective, 6% rated both methods the same, and no student rated the interview method less efficient.

In addition, the attitude survey revealed that students in the experimental group, in comparison to students in the control group, rated the course: as being more organized, as allowing more opportunity to proceed at an individual pace, as providing more stimulation to work in comparison to the level at which they usually work, as providing more effective interactions with other students in increasing learning, as stimulating more of an interest in pursuing further study in this area, as no more difficult, as more enjoyable, as utilizing a teaching procedure that they would prefer to be used in other courses, and as utilizing a text that was better and less difficult.

DISCUSSION

Two strong biases were introduced in this study which would favor higher achievement by students in the conventional instruction or control group on the final examination. First, 50% of the final grade in the course for students in the conventional instruction group was based on their performance on the final examination; students in the experimental group had already earned their grade before the final examination. Second, all of the students in the conventional instruction group

were required to study the entire text, their grade for the course depended upon this; however, only those 55 students in the experimental group who earned "A's" completed the entire text, the 58 students earning "B's" completed approximately three-fourths of the text, and the 51 students earning "C's" completed only approximately one-half of the text. These biases were introduced to subject the experimental teaching procedure to an extremely difficult test. Given these biases it is impressive that students in the experimental group achieved significantly higher scores on both the objective and essay final examinations than students in the conventional instruction group. The greatest difference in performance between the two groups was on the essay examination. This is expected because the interview procedure is designed to facilitate the development of verbal fluency. It is probable that the average achievement of students in the experimental group could be substantially increased by arranging the experimental course so that more of the students would complete a greater proportion of the course material. This could perhaps be achieved by reducing the total number of interviews required to cover the text, by increasing the number of interviews required to earn a "C" or "B", by encouraging students to begin taking interviews earlier in the course, or by increasing the duration of the course.

In addition to their superior achievement, students in the experimental group also expressed more positive attitudes regarding the course. These positive attitudes are probably a reflection of many of the positive features of the experimental teaching procedure, for example: the student is actively involved in the course, he is either speaking, listening, taking written exercises, or studying; the student progresses at his own pace, he is not forced to go ahead before he is ready, or held back by others; the student progresses in small steps and receives immediate feedback regarding the adequacy of his performance, this frequent evaluation teaches the student the level of study required in the course; the student's study behavior is reinforced by his own performance during the interview, as he is speaking he is also listening and differentially responding to the fluency of his verbal performance; the student progresses only after achieving complete mastery over a section, his

repertoire is tested in detail during the interview, not merely sampled; the student is not penalized for the repetition of unsatisfactory interviews or written exercises, this provides opportunities for remediation; the student is motivated by arranging an environment within which his progress is immediately reinforced, the aversive control exercised by the threat of tests and grades is minimized; the student's study is paced throughout the course, he does not concentrate his study toward the end of the course; the student does not compete with others for grades, he can cooperate with and assist other students without threatening his own grade; and the student's study habits are improved because the interview procedure teaches the student how to study effectively.

One possible objection to the experimental teaching procedure could be the 17% drop rate for the course. Students dropping the experimental course were interviewed to ascertain their reasons for not continuing. The most common response was that the course appeared to be too difficult and to involve too much work. This was stated succinctly by one student when he said: "Why should I go through all of that effort to learn this material when I can take a similar course from another professor and just cram the night before the final and get a "C" or a "B" without having to bother to learn anything." Several points can be made regarding the drop rate. First, most of the students in the course were sophomores; in two other courses, Developmental Psychology and Psychology of Learning, that the author has subsequently taught to juniors and seniors using the same experimental teaching procedure, the drop rate has been 9% and 6%, respectively. Second, the average drop rate for introductory psychology courses taught by the author in a conventional manner has ranged from 10 to 15% from year to year. Third, Ferster (1968) and McMichael and Corey (1969) reported drop rates of 13% and 12% respectively, for students enrolled in programmed courses.

The programming principles utilized in the design of the experimental teaching procedure are similar to those employed by McMichael and Corey (1969) in their experimental course, although the specific formats differ. The basic conclusion of this study is in agreement with McMichael and Corey (1969), who found the

experimental teaching procedure to be superior to conventional instruction procedures as measured by student achievement and student satisfaction. In addition, subsequent experience by the author and his colleagues in applying the experimental teaching procedure to courses in Developmental Psychology, Psychology of Learning, Behavioral Technologies, and Personality provide support for McMichael and Corey's (1969) statement that these procedures have wide generality and are applicable to general subject matter.

One of the most important features of the experimental teaching procedure was the employment of undergraduate teaching assistants. The significance of this experience for the undergraduate teaching assistant is difficult to assess. However, of the 12 teaching assistants in the course, nine of whom were seniors, eight of the nine were accepted into graduate programs in Psychology. Only three of these eight students were undergraduate psychology majors and only two had planned, before this experience as a teaching assistant, to enter graduate programs in psychology.

This study has convinced the author that the greatest untapped resource in the university today is the undergraduate student. By actively involving the undergraduate student in the teaching and learning process it is possible to individualize instruction, at no additional cost to the institution, even in introductory courses of 500 students or more. This is now being done as an accepted part of our introductory psychology program.

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