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ABSTRACT

A personalized system of instruction (PSI) was used to teach an undergraduate course in the principles and procedures of behavior modification. In most courses utilizing PSI, proctors grade quizzes and discuss the incorrect answers with the students. This study investigated the effect these discussions had on the students' quiz performance. The results indicated that the discussions produced only slightly higher scores on initial attempts at quizzes. However, students had to retake only 3% of their quizzes when they experienced discussion, whereas they had to retake 18% of their quizzes when they had no discussions. In addition, students answered questions concerning the general application of the principles and procedures of behavior modification both before and after taking the course. Their answers were then compared with the answers of a group of students who did not take the course. This comparison was made in order to see if a PSI course would produce a more general verbal repertoire than that which the course specifically required. The PSI students' answers to the general questions improved relative to their initial answers, whereas to other students' answers did not improve. (Author)

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Abstract

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[2]This paper is to be published in the proceedings of the First National Conference on Behavior Research and Technology in Higher Education held in Atlanta, Georgia, October, 1973. The authors wish to thank Dr. J. Iverson Riddle, Superintendent and Dr. Larry Larsen, Assistant Superintendent for Research and Education at Western Carolina Center for providing the facilities and materials necessary to produce this reprinting. We also thank Ms. Pat Minton for typing the many revisions the paper has experienced.

Proctors' Discussions Of Students' Quiz Performance With Students In A Self-Paced (PSI) Undergraduate Course[1,2]

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Since the personalized system of instruction (PSI) format was first proposed and implemented by Keller (1968), many studies have been carried out to compare its effectiveness with the more traditional lecture-exam format (e.g., Alba & Pennypacker, 1972; Keller, 1968; McMichael & Corey, 1969; Sheppard & MacDermot, 1970). The results of these studies have indicated that the PSI format (or slight variations of it) produced higher student performance on final exams and higher student ratings of the course than the same materials presented in a lecture-exam format.

The PSI format typically consists of five or six components. These components include: allowing students to proceed through the course at their own pace; dividing the course materials into a number of units; providing study questions for each of the units; requiring students to pass quizzes over each unit with almost perfect scores before they are allowed to proceed; having students who have already mastered the course materials serve as proctors who correct the students' quizzes, discuss the incorrect answers with the students, answer any questions the students have and tutor students on difficult materials; and having only a few optional lectures. To implement these components requires a large investment of time, materials and money. Because of this large investment it is important to experimentally investigate which of the above components are necessary for PSI's effectiveness and which may not be essential.

The following studies (among others) have experimentally investigated the effectiveness of the above components. Lloyd (1971) found that instructor pacing produced higher and more consistant student performance than did allowing students to pace themselves (given fixed, end-of-semester or end-of-term deadlines). Semb (1973) found that dividing the course materials into many small units produced consistantly higher student performance than did dividing the course materials into larger units. Weaver & Miller (1973) also found that having many units with frequent quizzing was superior to having larger units with infrequent testing. The effects of having study questions (from which quiz questions were taken) was investigated by Semb, Hopkins, & Hursh (1973). Their results indicated that the study questions the students were previously exposed to were correctly answered more than were questions to which the students had not previously been exposed. Johnston & O'Neil (1973) & Semb (1973) found that the criterion set for passing quizzes is directly related to the level achieved by students. That is, high, "mastery" criteria maintain high quiz performance and lower criteria maintain lower quiz performance. Having proctors who interact with students when correcting some or all of the course quizzes has been shown to be more effective than not having proctors (Farmer, Lachter, Blaustein, & Cole, 1972). Lloyd, Garlington, Lowry, Burgess, Euler, & Knowlton (1972) found that optional lectures do not serve as reinforcers for students' performance in the course. Thus, the experimental evidence supports the effectiveness of the use of small units, study questions, frequent quizzes with high "mastery" criterion for passing and proctors to correct

and discuss quiz answers with students. However, it appears that self-pacing (given semester or term deadlines) and optional lectures are components that do not function to effectively maintain higher student performance.

Keller (1968) emphasized the importance of using proctors by noting that it allows for frequent quizzing, immediate feedback, discussion with students and tutoring of students. The data (Farmer, er al., 1972) appear to support Keller's (1968) emphasis. However, proctoring involves many behaviors and it is not clear which of these many behaviors are functionally related to students' performance. The present study evaluated whether proctors' discussions with students about their incorrect answers facilitated their test performance and whether or not the students preferred to have such discussions. Further, this study evaluated whether the students were able to apply the specific information they were required to learn during the course to general questions concerning the subject matter.

Method

Students and proctors

Thirty-four students at the University of Kansas who were enrolled in a PSI course entitled "The Principles and Procedures of Behavior Modification" took part in the present study. Four other undergraduates who had completed the course materials served as proctors for the course.

Settings and class meetings

A university classroom served as the setting for the class meetings. Class met for one hour, three days a week throughout the semester. With the exception of the first and last two days students were free to attend class for the purpose of studying and/or taking quizzes whenever they chose.

Procedures and experimental design

Students in the course were required to pass all quizzes over the course readings with at least nine out of ten correct in order to receive an "A" grade for the course. On each quiz the students were allowed as many retakes as necessary to achieve the 90% correct criterion. If a student failed to complete all 17 quizzes by the end of the semester he was given a withdrawal instead of an "A" grade.

The 34 students were divided into two groups. With one group of students

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Insert Figure 1 about here

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the proctors discussed incorrect answers on the first five quizzes but not on the second five quizzes. With the other group of students, the proctors did not discuss incorrect answers on the first five quizzes but did not on the second five quizzes. On the final seven quizzes all students chose, on each quiz, whether or not to have the proctor discuss the incorrect answers with them. If a proctor was to discuss an incorrect answer to a quiz question with a student, he gave the student prompts, discussed relevant information and/or asked leading questions until the student correctly answered the question or it became obvious that the student

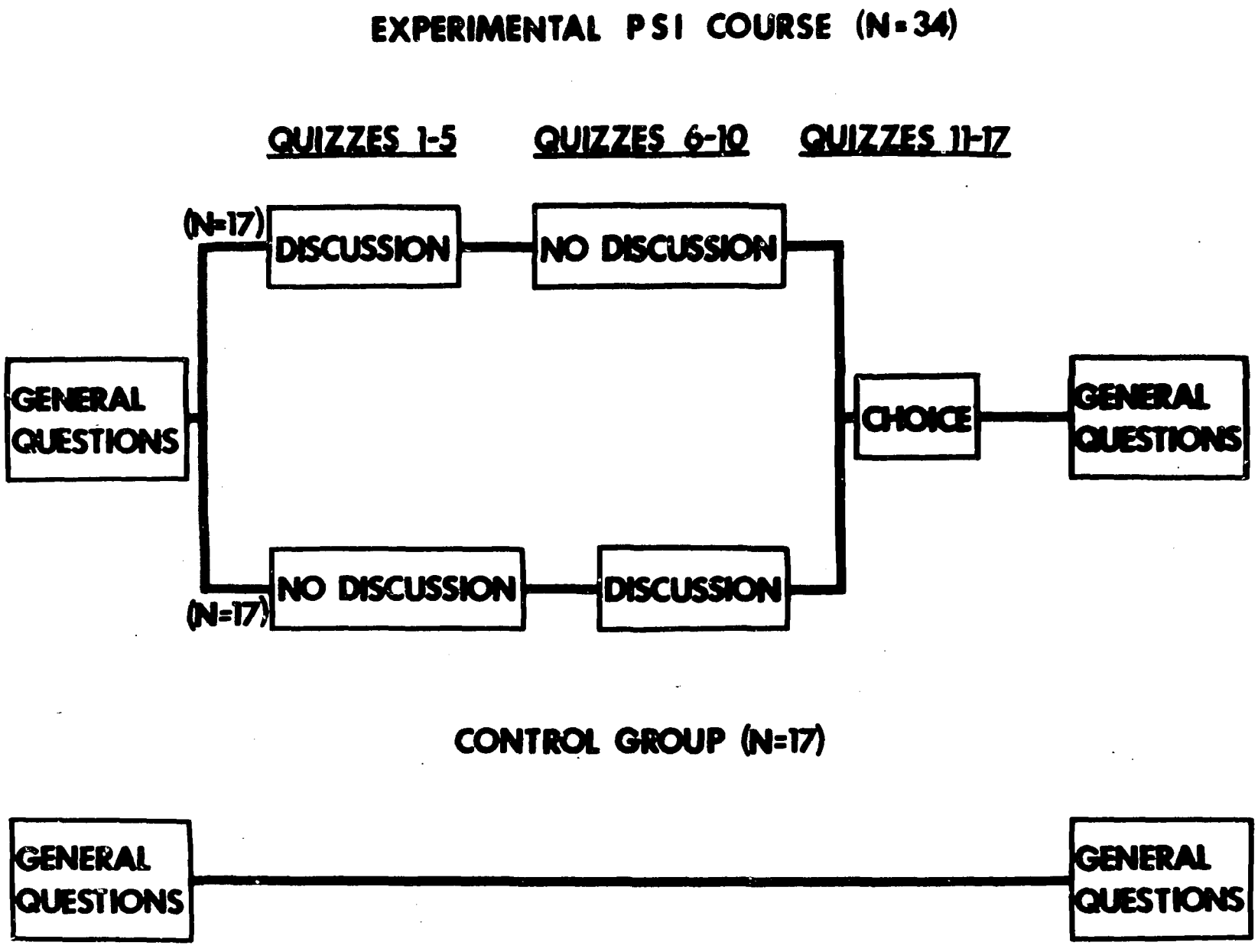

Figure One: The experimental design depicting the sequence of conditions each group of students experienced.

could not answer the question. If the student could correctly answer the question during the discussion he was given credit for it. If the proctor was not to discuss incorrect answers with the student, the proctor merely told the student his score and pointed out which answers were incorrect. A graduate student or professor was always available in the classroom to answer any questions the students had about the readings, study questions or their answers to quiz questions. The graduate student or professor, however, did not change the grading done by the proctors. After finishing the course, students completed a course evaluation that asked them which components of the PSI package they found helpful add how they would rate the course in comparison to the other courses they had taken.

Before beginning the course and then again after they passed their last quiz, all students in the course answered general questions over the course materials. These questions asked the student to describe behavior modification programs (e.g., to toilet train a child), design studies (e.g., to experimentally analyze the effects of a behavior modification precedure) and describe the circumstances that would lead one to use a punishment procedure to modify behavior. Another group of students enrolled in a PSI course in Nutrition also answered the general questions. From this group 17 students were chosen such that the mean of their scores matched the mean of the experimental class's scores and their individual scores matched the scores of 17 of the 34 students in the experimental class. Each of these 17 control students then answered the general questions a second time after an interval equivalent to the time it took the student they were matched with to complete the course. All students were simply asked to complete the test both times. There were no contingencies for completeness or accuracy.

Observation and recording

Data was collected on both quiz scores and answers to the general questions. Periodically interobserver reliability was assessed. On an answer-by-answer basis mean intergrader reliability was 98% for the quizzes and 88% for the general questions

Results

All students on their first attempt on all quizzes scored a mean of 96% correct. For quizzes on which students discussed their incorrect answers with the proctors,

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Insert Figure 2 about here

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they scored a mean of 98% correct on their first attempts. For quizzes on which students did not discuss their incorrect answers with the proctors, they scored a mean of 94% correct on their first attempts. Thus, the discussion of incorrect answers produced only slightly higher scores on first attempts than did no discussion. However, when given a choice between discussion and no discussion students chose to discuss their incorrect answers with a proctor on 237 of the 238 occasions to choose (7 choice quizzes x 34 students). In addition, students had to retake 18% of their quizzes when they were not given a chance to discuss their incorrect answers, whereas, when given a chance to discuss and potentially change their incorrect answers students had to retake only 3% of their quizzes. However, if students' initially incorrect answers had not been corrected during the discussions they would have had to retake 35% of their quizzes.

Insert Figure 3 about here

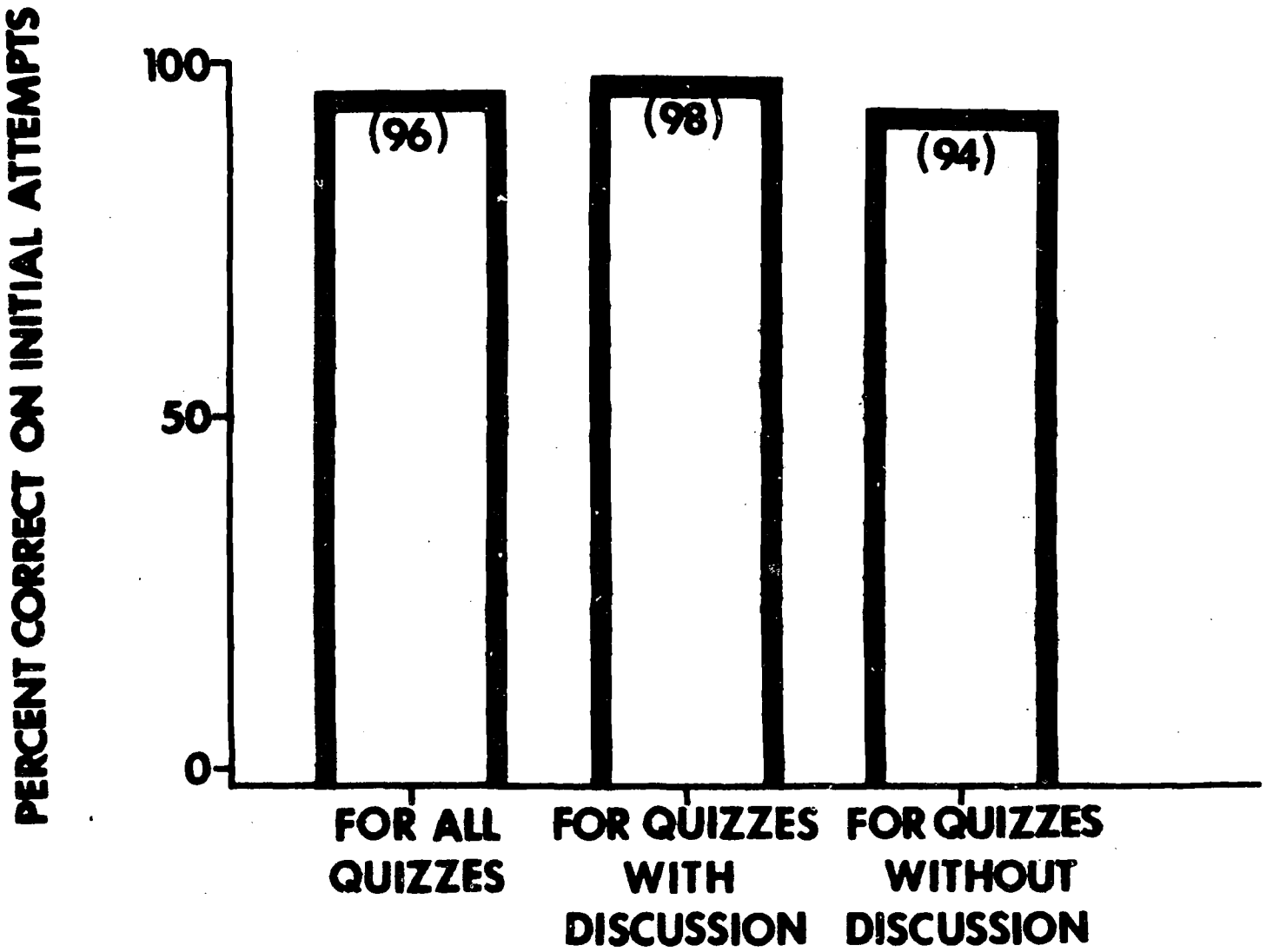

Figure Two: The students' mean percent correct on their initial quiz attempts on all quizzes, quizzes with discussion and quizzes without discussion.

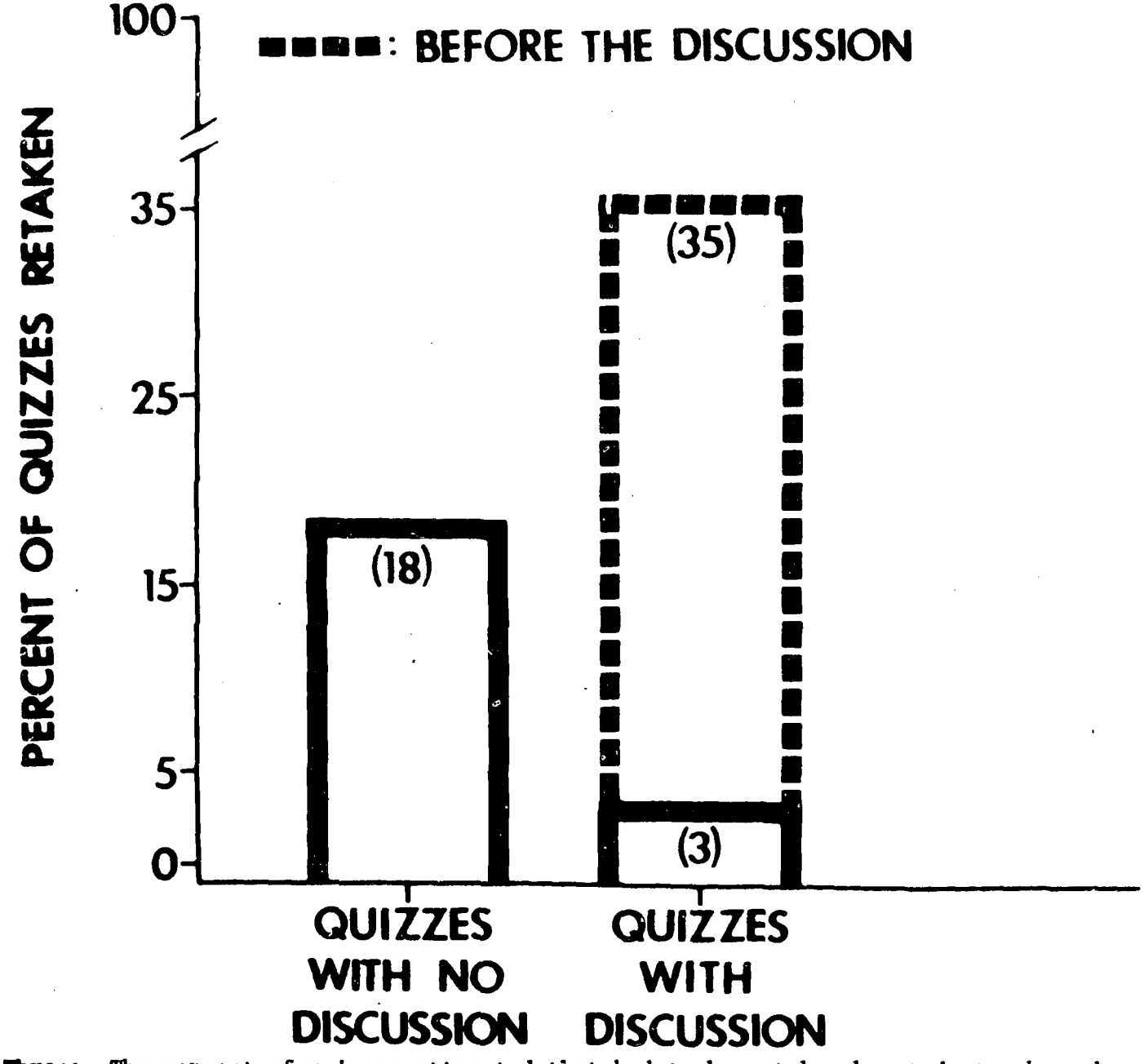

Figure Three: The percent of quizzes attempted that had to be retaken by students when they had no discussions and when they had discussions. The dashed bar represents the percent of quizzes that would have had to be retaken if the students had not had the chance to change initially incorrect answers during the discussion with the proctors.

In the experimental course, students' answers to the general questions contained a mean of 7.9 of the possible 26 points before they experienced the

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course and a mean of 11.5 after they had completed the course. The students not in the experimental course scored a mean of 7.8 initially and 7.4 on their second attempt. Thus, students in the experimental course increased their performance on the general questions, whereas, the other students did not.

A supplementary finding was that all students took and passed quizzes more frequently as they progressed through the course. Thus, a cumulative record of their quiz passing performance resembles the scallop-like pattern of responding

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Insert Figure 5 about here

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characteristic of animal (Ferster & Skinner, 1957) and human (Mawhinney, Bostow, Laws, Blumenfeld, & Hopkins, 1971) responding when under a fixed-interval schedule of reinforcement.

On the course evaluation the students rated the experimental course as more interesting than other courses they had taken (5.9 on a seven-point scale where 1= much less interesting than and 7= much more interesting than) and more work than other courses (4.9 on a seven point scale where 1= much less than and 7= much more than). On a seven-point scale (where 1= a hindrance and 7= very helpful), students rated the helpfulness of having proctors at 6.4, being able to pace themselves at 6.9, having study guide questions at 7.0 and being required to pass quizzes without least 9 out of 10 correct at 6.5.

Discussion

Discussions produced almost no increase in students' mean accuracy when initially answering quiz questions. However, it appears that students were better prepared to initially provide correct answers to the quiz questions when they were not given a chance to discuss and potentially change their incorrect answers. They had to retake 18% of their quizzes when they had no discussion but would have had to retake 35% of their quizzes if they had not been able to change some of their initially incorrect answers during discussions with the proctors, Giving the students the chance to change their initially incorrect answers in discussions with their proctors almost eliminated the need for retakes (only 3%). Another important finding was that, after having experienced both discussions and no discussions, students almost always chose to have discussions when given the option.

One potential criticism of PSI is that it appears to teach only a specifically defined and limited repertoire rather than setting the occasion for a more general repertoire with respect to the subject matter. The general questions in this study were used to test whether this PSI format could produce a more general repertoire than that which was specifically required as part of the course itself. The results from these general questions appear to indicate that PSI can teach a more general repertoire. Having students from another course answer the same questions only provided a control for the possibility that the passage of time itself could

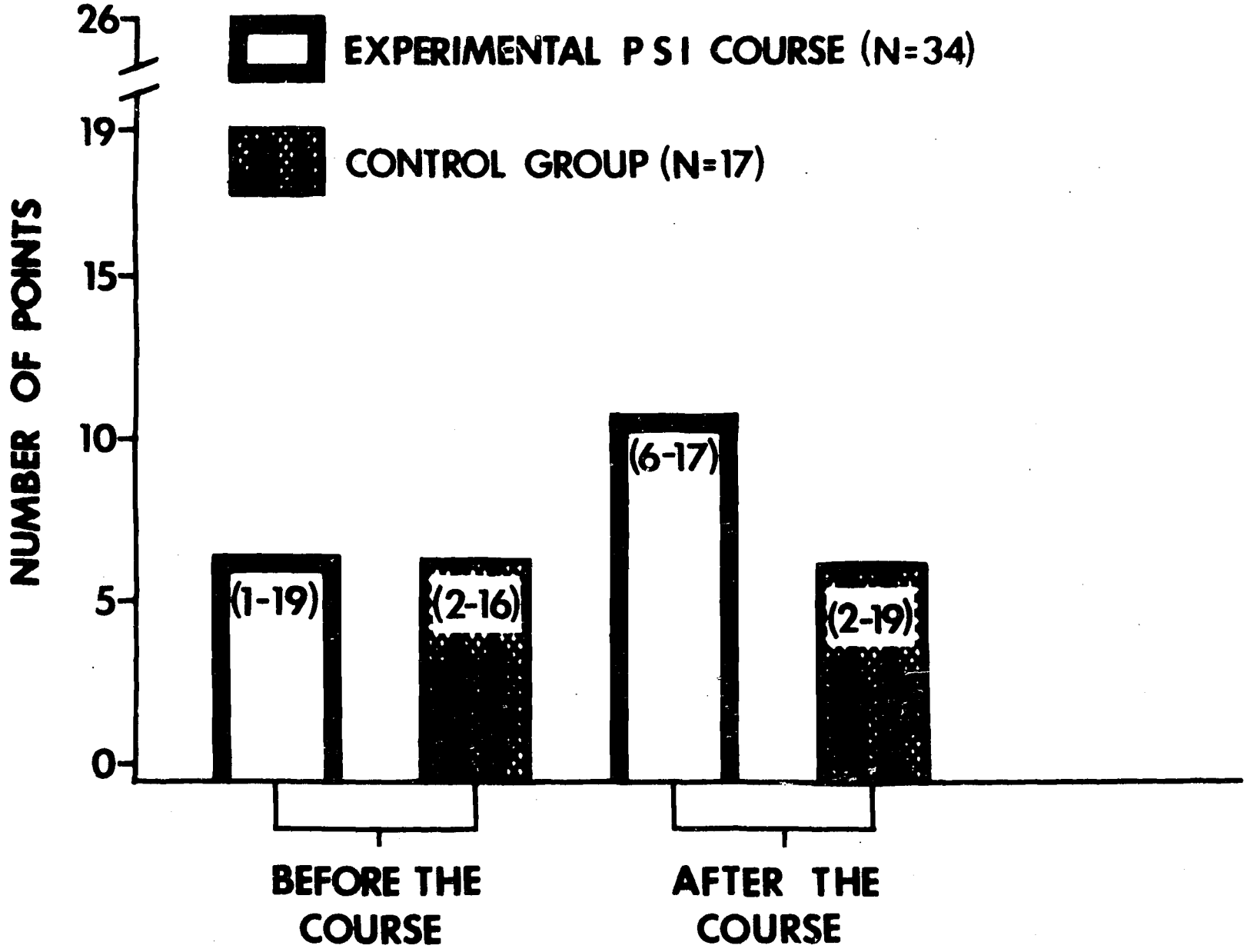

Figure Four: The experimental PSI class and the control group's mean and range (the numbers within the bars) of scores on their answers to the general questions.

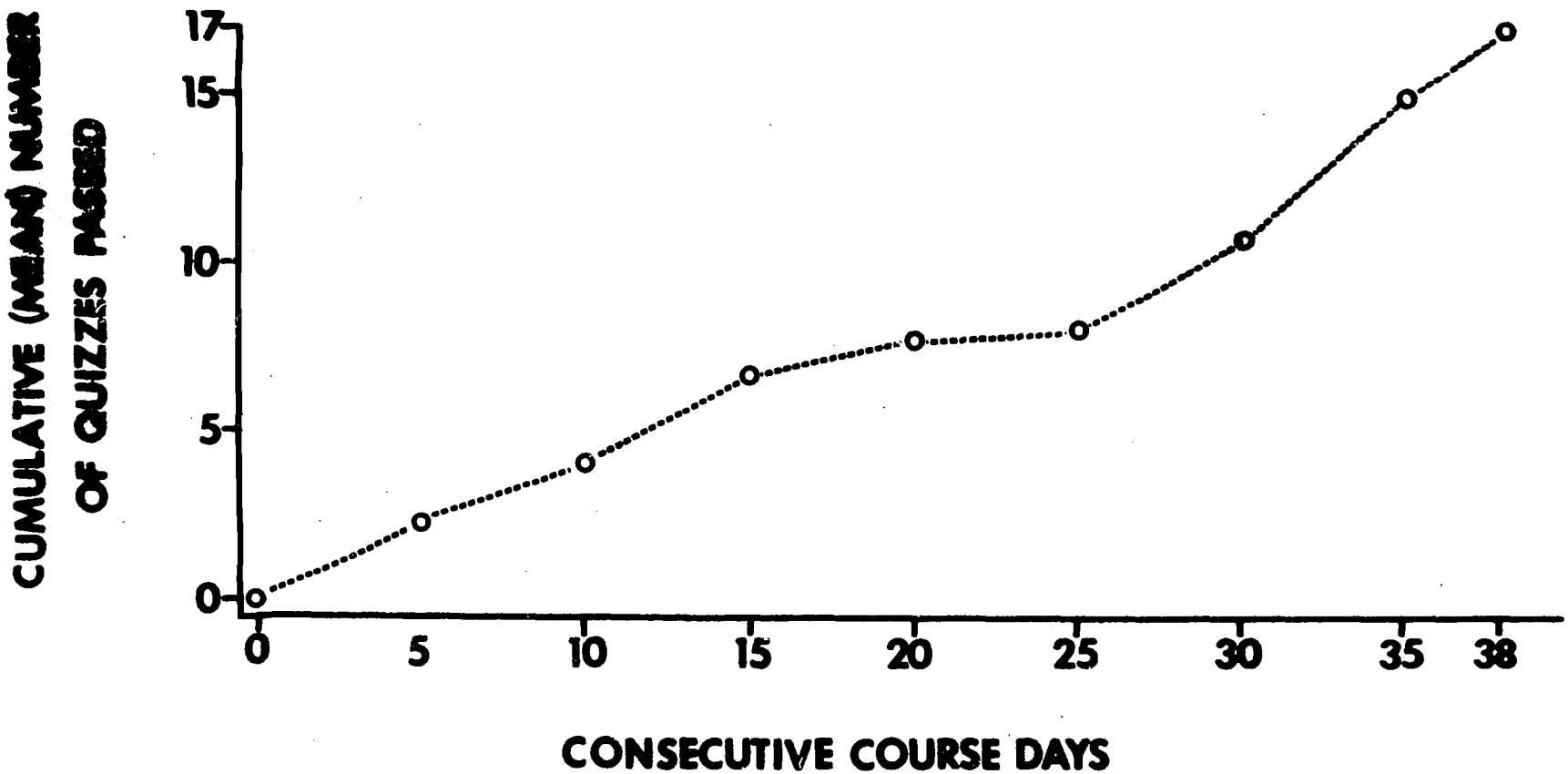

Figure Five: The cumulative (mean) number of quizzes passed by all students at five day intervals throughout the experimental PSI course.

account for the increased scores of students in the experimental PSI course. Further evaluations of this issue will need to include comparisons between PSI techniques and other teaching methods.

The results of the course evaluations indicated, as did earlier studies, that students report finding PSI more interesting, even though it requires more work, than other courses they had taken. In the present study students were also asked how helpful the different PSI components were. Their responses to these questions indicated that the students found each of the components very helpful.

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