The Effects of Two Types of Remedial Procedures on Test Performance of Middle School Students

Linda Borgman

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THE EFFECTS OF TWO TYPES OF REMEDIAL PROCEDURES ON TEST PERFORMANCE OF MIDDLE SCHOOL STUDENTS

by

Linda Borgman

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

Western Michigan University
Kalamazoo, Michigan
August 1977
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Linda Borgman
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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>METHOD</td>
<td>9</td>
</tr>
<tr>
<td>Subjects</td>
<td>9</td>
</tr>
<tr>
<td>Materials</td>
<td>10</td>
</tr>
<tr>
<td>Procedure</td>
<td>14</td>
</tr>
<tr>
<td>RESULTS</td>
<td>18</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>22</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>32</td>
</tr>
<tr>
<td>APPENDIX</td>
<td>33</td>
</tr>
</tbody>
</table>
INTRODUCTION

One of the many problems a school teacher faces today is what to do with students who fail to master the required academic material at its initial presentation. Most teachers feel that a second attempt should be made to teach the student the material, but there seems to be no general agreement concerning what type of remedial procedure to use.

A review of the literature reveals few studies contrasting different types of remedial techniques, and the results of the existing studies are contradictory. A study by M. David Merrill (1965) investigated the effects of mastering each successive part of a hierarchical task before proceeding to the next part of the material. Adult subjects were assigned to five experimental groups, and then required to take six hours of learning lessons on a computer-based teaching machine system. The task to be learned was an imaginary science, and it was presented in a hierarchical structure through a series of learning sets. The treatment of each group differed according to whether or not the group received a correction/review series on the lessons and/or quizzes presented by the computer program. A correction/review set was implemented when a subject answered a question incorrectly, and through it he was provided with feedback on his answer and then review statements of previously presented material that was prerequisite to proper responding to the item failed. The subject
was then permitted to correct his original incorrect response. According to final test scores covering the lessons presented by the instructional program, there was no significant difference in the mean number of errors made by the five experimental groups. However, subjects in the correction/review groups took a significantly greater amount of time to complete both the lessons and the test than the subjects of the other three groups. These results indicate that a remedial program consisting of the presentation of review prerequisite material does not decrease the number of errors made on a final test, and it also seems to increase the amount of time required by a student to complete both the instructional program and the final test.

Merrill, Barton, and Wood (1970) conducted a similar study in an attempt to replicate and extend the Merrill (1965) study. The purpose of this experiment was to test the hypothesis that students who receive specific review in learning a task will make fewer errors and require less time to complete each part of the task and a criterion test. The experimenters used an Autotutor Mark II teaching machine, which presented programmed instruction to students through the use of presentation frames and specific review frames. On presentation frames the students received lessons on the use of an imaginary science, and each frame explained a concept or principle and then asked a question. The students received feedback on the accuracy of their response to the question on each presentation frame. On specific review frames, a
step-by-step solution to the presentation frame problem was presented, and the student was required to supply the final step of the problem. The presentation frame problem was always repeated on its corresponding specific review frame.

The subjects of this experiment were forty college students, and they were randomly assigned to eight experimental conditions. Groups 1-4 received lessons on the presentation frames, and they were shown a specific review frame if they failed to answer a question on a presentation frame correctly. Groups 5-8 received feedback on the correctness of their responses to the presentation frames, but they were not shown any specific review frames. At the conclusion of four lessons the students took two criterion tests, the first immediately following the final lesson and the second administered as a retention test three weeks later. The experimenters found that there was no significant difference between the mean number of errors made by the groups who received the specific review frames and the groups that did not, on either the lessons or the criterion tests. The data also showed that the students receiving specific review frames spent less time on the lessons, but approximately the same amount of time on the criterion tests, as the students who received only the presentation frames. Therefore, this study replicated some of the findings of the previously conducted Merrill study (1965), for a remediation procedure consisting of the presentation of review prerequisite material did not result in fewer errors on a final criterion test,
as compared to a control group. However, in contrast to the initial Merrill study, the second study did show that students receiving a review remediation procedure required less time to complete the instructional program than a control group of students who received only the presentation of the instructional lessons.

Okey, Brown, and Fiel (1972) conducted an experiment to determine the effectiveness of incorporating diagnostic testing and remedial procedures into a hierarchically based audio-tutorial instructional program. The students were presented with lessons that were designed to teach ten subordinate skills and a terminal task. First a student would work through the materials designed to teach one of the tasks in the hierarchy. Then the instructor would present the student with a test item to determine if the student had mastered the task just presented. If the student passed the test item he continued to work within the audio-tutorial program on the next highest task. If he failed the test item, the instructor assigned additional practice exercises to remediate the learning problem. The student was presented with a single practice problem at a time, and when he had answered one problem correctly he returned to the regular instructional program at the next highest level. The students, who were sixty teachers enrolled in the same college course, were randomly divided into three groups. One group received the entire audio-tutorial instructional program, including diagnostic testing and remediation
through practice items. A second group received the tutorial program without the remediation problems. The third group served as a control group and received unrelated instruction. All learners took both a pretest and a posttest on the material taught by the instructional program. No significant difference was found between the mean test scores of the students in the group receiving the entire program (including remediation), and the group receiving tutorial instruction alone. However, the mean test scores of both groups receiving the instructional program differed significantly from the scores of the control group. Therefore, the authors concluded that the tutorial program was effective in teaching the skills it presented, but the program involving frequent diagnostic testing and remediation produced no significant effect over instruction with no attempt to locate and remediate errors in learning.

An article by Ronald L. Fiel and James R. Okey (1975) describes an attempt to test Gagne's hypothesis that teaching prerequisites is more effective than repetition of the goal task in learning intellectual skills. Eighth grade science students were divided into three groups—those receiving prerequisite skill remediation, those receiving practice on goal tasks, and a control group receiving no remediation. A tape-slide program on constructing a table of data was presented to all the students, and they were then required to take a diagnostic test covering the objectives of the instructional program. Subjects in the
remedial groups who were not successful on a particular test item were provided with remedial activities that supplemented the mainline instruction. Following three presentations of the instructional-diagnostic test-remedial activity sequence, all students were given a criterion test covering the material presented throughout the six class periods used in the study. Statistical comparisons were made between the mean accuracy scores of each group on the criterion test. The results showed that there was a significant difference between the scores of the two groups receiving remediation and the third group that received no remediation. There was also a significant difference between those subjects receiving instruction on prerequisite skills as remediation and those receiving additional practice remediation. These results indicated that additional instruction on prerequisites was more effective in improving achievement than additional practice remediation, and that both of these procedures were more effective than no remediation. However, since the population and subject area were very limited and the remediation procedure itself was administered only three times, the results of the study are far from conclusive.

The studies mentioned above all used instructional programs based on special audio-visual equipment or teaching machines. No attempt was made to incorporate the two types of remediation procedures into a regular classroom situation, with a single instructor and no access to specialized teaching equipment. Also,
all of the studies but one used subjects who were either college students or adults. An investigation of the effectiveness of remedial techniques that can be employed in a regular classroom situation is of particular importance because of the increasing number of children who fail to learn part of the basic material provided for them at successive grade levels in school. These students are the typical victims of "cumulative failure"--because they do not master academic skills in the elementary and primary grades, they are unprepared to learn the more advanced material of higher grades, and consequently fall further and further behind. The present study was designed to contrast the effects of two types of remedial activities that could be conveniently incorporated into a traditional junior high classroom setting. The remedial activities were repetition and drill of the goal task, and the teaching of a hierarchy of prerequisite skills necessary for the performance of the goal task. The effects of both types of remedial procedures were also compared with the effects of baseline conditions in which students received only mainline instruction without any kind of remediation. The data obtained were analyzed to determine if remediation could be effective in increasing the academic performance of low-achieving students, which is a major concern of teachers in mainstream education.

The subjects of this study were students of two fifth grade science classes. They were taught in instructional units, each
of which contained from one to three unit quizzes and a final unit test. During experimental conditions, students who achieved less than criterion level of performance on a unit quiz were assigned remedial activities to be completed before the unit test. The difference between the mean quiz score (percent correct) and the unit test score for each student during each instructional unit was used as the dependent variable, to assess the effectiveness of the remedial activities in increasing academic achievement.

Three different experimental conditions were implemented over the course of this study. During the baseline condition, students received regular classroom instruction and took all unit quizzes and the unit test. The percent correct on the quizzes and test was recorded for each student, but no attempt was made to remediate any errors made on the quizzes. In the Repetition and Drill (R/D) experimental condition, those students who answered less than seventy percent of the questions correctly on a unit quiz were required to complete a remedial worksheet. The worksheet was composed of questions similar to those on the quiz, and at least two questions on the worksheet corresponded to each quiz question. The R/D worksheet was intended to provide the students with practice items similar to the questions asked on the unit quiz. In the second experimental condition, the students obtaining less than seventy percent accuracy on a unit quiz were assigned a different type of remedial activity, an Additional Instruction worksheet (AI). For each quiz question or group of
related questions, a paragraph was included that presented material related to that question. Most of the information provided in the paragraph was an explanation of the meaning of the words and/or relationships a student would have to be aware of in order to successfully answer the corresponding quiz question. Following each paragraph, the AI worksheet presented several questions relating to the information provided in that paragraph. The questions were sequenced in order of increasing difficulty, so that students could obtain the correct answers to later questions by answering previous ones correctly.

METHOD

Subjects

The subjects of this study were fifth grade students from Schoolcraft Middle School. The students were members of two general science classes which were taught by the same instructor and covered identical academic material. The number of students in each classroom fluctuated slightly through the course of the study, due to schedule changes and students moving both into and out of the Schoolcraft School District. Data will be presented on those students who were present for at least three phases of the study, and this will include eighteen students in the first classroom and twenty students in the second classroom.
Materials

The textbook used in both classrooms was *Science: Understanding Your Environment* (Mallinson, Mallinson, Brown and Smallwood, 1972). The textbook material used during the study included units four through nine (pages 55-121). Several filmstrips, supplementary to the mainline classroom instruction, were also shown to the students. During some units, the students were given worksheet assignments to complete with the aid of their textbooks. These worksheets were developed by the classroom teacher, and consisted of questions directly related to the reading material presented in the textbook.

For each unit of instruction, the students were required to take from one to three unit quizzes, and a final unit test. Both the quizzes and the test were based on the instructional objectives the teacher had developed for that particular unit of instruction. The majority of the instructional objectives were at the Knowledge or Comprehension level (Vargas, 1972), and involved tasks such as matching vocabulary words to their definitions, identifying functions of plant parts, and placing rocks and minerals into their correct scientific category.

Each quiz was based on the objectives that were presented to the students immediately preceding that quiz. The mean number of questions on each quiz was approximately nine, but some questions required the students to make more than one response to receive total credit for that question. The majority of the items on the
quizzes were matching, short answer (requiring a few words written by the student) and fill-in-the-blank sentence completion. On sentence completion items, the students were usually provided with a word list containing the answers, but occasionally they were asked to recall the correct answers from memory.

As mentioned previously, each instructional unit included from one to three quizzes. In a unit including more than one quiz, the items on each quiz were largely independent of the questions asked on other quizzes within that unit. The first quiz assessed the objectives taught from the onset of the unit until the day of that quiz. A second quiz assessed the objectives presented during the time period immediately following the first quiz and continuing until the day of the second quiz. There was a small amount of overlap on quiz items within a unit, but the majority of quiz questions were presented only once, on a single unit quiz.

The test presented at the conclusion of an instructional unit was an assessment of all the objectives taught within that unit. The majority of the test items were similar or identical to items that had been previously presented to the students on unit quizzes. Therefore, each unit test was a collection of items from previous unit quizzes, and served as a review of the entire unit. The mean number of questions on each unit test was approximately 19, although many questions had several parts requiring individual responses. The type of questions asked on
the unit tests were similar to those asked on the quizzes, including matching, short answer, and sentence completion.

Two types of remedial materials were presented to the students during the study. Both types were worksheets that the students were required to read and complete by writing answers to questions. Each worksheet was designed specifically to remediate the objectives assessed by a single unit quiz. Therefore, for each quiz a corresponding remedial worksheet was developed that pertained to material covered on that particular quiz.

One type of remedial worksheet consisted of items that duplicated the questions asked on the previous quiz. This type of activity was called Repitition and Drill (R/D). For each question on the quiz, at least two similar questions were included on the R/D worksheet. The quiz questions were generally re-worded or presented in a different form (fill-in-the-blank instead of matching) to avoid making the worksheet overly monotonous for the students. The mean number of questions on each R/D worksheet was approximately 21, although some questions required multiple responses. The R/D worksheets did not provide the students with any new instructional information, and they did not include any questions that had not been assessed on the corresponding quiz. Therefore, the R/D worksheet provided the students with drill on the quiz items by presenting a minimum of two questions corresponding to each quiz item.
The second type of remedial worksheet was designed to provide additional instruction (AI) on objectives prerequisite to those taught in the mainline instruction. For each quiz item or group of related items, a paragraph was presented on the AI worksheet that presented material related to that quiz question. Most of the information in the paragraph was related to the definition of words that a student would have to know in order to answer the quiz question correctly. The paragraph also provided the student with a general orientation toward the quiz question by explaining its relationship to the common knowledge and everyday experiences that the student was already familiar with. Each paragraph attempted to present the student with information sequenced in a logical order, from simple definitions to more complex concepts and relationships, building to the actual material assessed by the corresponding quiz question.

Following each paragraph, the AI worksheet presented several questions relating to the information provided in that paragraph. The mean number of questions asked on each AI worksheet was approximately 34, although once again some questions had more than one part. The majority of the questions were sentence completion or short answer items, requiring two or three-word written responses. The questions were placed in a logical order of difficulty that would enable the student to find the correct answer of a more difficult question by correctly answering simple questions asked previously. In other words, the student was led
to a correct response on an item taken from the mainline instruction if he correctly responded to simpler questions that clarified the concepts involved in answering the quiz question correctly.

Procedure

This study was initiated early in the fall semester of 1976, and the final data collection occurred in February, 1977. This represented a period of fourteen school weeks, since vacations and snow days totaled three weeks of the entire seventeen-week time period. The study was organized into seven separate phases, each of which was a single instructional unit as planned by the classroom teacher. Each unit was approximately two weeks, or ten school days, in length.

The students within each of the two classrooms were randomly assigned to one of three treatment groups (A, B, or C), with the use of a table of random numbers. There were a total of 11, 13, and 14 students in groups A, B, and C respectively. The students were grouped to facilitate treatment assignments, but data was collected and recorded on each individual student's performance through all phases of the study. A multiple baseline design was used to determine when the students of each treatment group would receive either the repetition and drill work, the additional instruction remedial work, or no remedial work (baseline). During Phase I, all groups were under baseline conditions and the students received no remedial assignments, regardless of their quiz scores. During Phase II, target students of group A received R/D worksheets
but students in groups B and C remained under baseline conditions. Target students were defined as those students who qualified for a remediation activity due to a score of lower than 70% correct on a unit quiz. During Phase III, target students of groups A and B received R/D worksheet assignments while group C remained in baseline. Each group remained in the R/D experimental condition for three consecutive phases, and then received the AI treatment until the conclusion of the study. Therefore, AI was initiated in group A in Phase V, group B in Phase VI, and group C in Phase VII.

At the outset of each instructional unit, the teacher organized the unit into one, two, or three separate sections, according to the natural relationship between objectives in that unit. The teacher identified the objectives he was to teach in the first section, and then instructed the students for a two or three-day period. Mainline instruction included lectures, class discussions, worksheets, assigned reading in the textbook, and occasional demonstrations and filmstrips. When the instruction of the first section of the unit was completed, as determined by the teacher, a quiz was administered to assess the students' achievement of the objectives that were taught in that section. The quizzes were graded by the experimenter and returned to the teacher on the following day. All students who received a score of less than 70% correct on the quiz became target students for that unit (phase). These students received either no remediation, repetition and drill activities (R/D), or additional instruction
activities (AI) following each quiz, depending upon which treatment group they had been assigned to. If a student qualified to receive a R/D or AI worksheet, the experimenter reviewed his quiz and noted which specific questions the student had failed to answer correctly. A worksheet was then prepared for him, and the numbers of the questions he was required to answer on the worksheet were circled in red. The student was only required to answer those questions on the worksheet that corresponded to the questions he had missed on the quiz. In this way, the student was not required to engage in "busy work"; he completed only those items that he had shown on the quiz he did not know. The teacher delivered the worksheet to each student individually, and explained that it was a special worksheet designed for him to help him prepare for the unit test, since he had received a D or E on the previous quiz. The student was also told that his grade on the worksheet would be considered in the determination of this 6-weeks report card grade. During Phases I through IV, the teacher simply gave the worksheets to the students and told them to complete the work and return them within two school days. However, since many of the papers were lost or forgotten at home by the students, during Phases V through VII the students were given time in class specifically for the purpose of completing their worksheets. The time required for worksheet completion was approximately ten to twenty minutes, depending upon the individual student's work speed and the number of questions he was required to complete.
the phases in which this time was part of the regular class period, the students with no worksheet assignment received free-time privileges during that time period. Therefore, the target students did not miss regular classroom instruction when they worked on their remedial worksheets.

When the students completed their remedial activities, they returned the worksheets to the teacher. The experimenter graded the worksheets and returned them to the students within two days of their completion. During phases I through IV of the experiment, no accuracy criterion was placed on the remedial worksheets. However, since some students were turning in papers with only 50% or fewer of the questions answered correctly, a criterion of 70% accuracy was established. If a student responded to less than 70% of the questions on the remedial sheet correctly, he was required to complete the worksheet a second time, and correct the errors made on his first attempt. If a student failed to reach the 70% criterion on his second attempt, the work was not re-assigned due to the necessity of keeping to the teacher's planned time schedule for the class.

After the first quiz had been administered in each unit, the teacher proceeded to instruct the students on the material included in the second section of that unit. A second quiz was administered over that material, and remedial worksheets were assigned to target students. At the conclusion of the instruction for each unit, all students took a unit test consisting of items similar to those
presented on the unit quizzes. The difference in percent between the mean quiz score and the test score for that unit was recorded for each target student. This difference score was used as the dependent variable in order to assess the effectiveness of the remedial worksheets in improving students' academic performance. Students who scored above the criterion level on all quizzes in a single phase were not treated as subjects during that phase of the study.

RESULTS

Difference scores for each subject in each phase were computed by subtracting the mean percent correct on the quizzes of each instructional unit from the percent correct on each unit test. The mean of the difference scores for each treatment was calculated for each subject. These mean difference scores were then analyzed by a 2-way repeated measure analysis of variance (ANOVA), using only the scores of those subjects who qualified for both types of remedial procedures at least once. Table 1 gives the number of subjects in each group and the mean difference scores for each group for each treatment condition.

A comparison of the mean difference scores of groups A, B, and C indicated that there is no significant difference between the mean scores of the three groups for the three different treatment procedures, \( F(2, 18)=1.238 \). The pattern of treatment presentation had no significant effect upon the performance of the students, as measured by quiz and test scores.
### TABLE 1
Mean Difference Scores for Groups A, B, and C
Across Three Treatment Conditions

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Baseline</th>
<th>R/D</th>
<th>AI</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>8</td>
<td>22.625</td>
<td>5.650</td>
<td>17,600</td>
</tr>
<tr>
<td>B</td>
<td>6</td>
<td>8,333</td>
<td>9.717</td>
<td>24.333</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>4.900</td>
<td>11.943</td>
<td>11.429</td>
</tr>
</tbody>
</table>

A comparison of the two treatment procedures, R/D and AI, and a baseline measure revealed a significant difference between the three groups, $F(2, 36)=3.763$, $p<.05$. The results of the repeated measure ANOVA are reported in Table 2.

### TABLE 2
Two-Way Repeated Measure ANOVA

<table>
<thead>
<tr>
<th>Sources of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratios</th>
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<tr>
<td>Between Ss A</td>
<td>3451.5192</td>
<td>20</td>
<td>172.5760</td>
<td>1.238</td>
</tr>
<tr>
<td></td>
<td>417.5067</td>
<td>2</td>
<td>208.7534</td>
<td></td>
</tr>
<tr>
<td>Ss Within Groups</td>
<td>3034.4601</td>
<td>18</td>
<td>168.5562</td>
<td></td>
</tr>
<tr>
<td>Within Ss B</td>
<td>6073.4601</td>
<td>42</td>
<td>144.6062</td>
<td></td>
</tr>
<tr>
<td></td>
<td>773.1677</td>
<td>2</td>
<td>386.5839</td>
<td>3.763</td>
</tr>
<tr>
<td>AB</td>
<td>1602.3033</td>
<td>4</td>
<td>400.5758</td>
<td>3.900</td>
</tr>
<tr>
<td>B Ss Within Groups</td>
<td>3697.9891</td>
<td>36</td>
<td>102.7219</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>9524.9792</td>
<td>62</td>
<td></td>
<td></td>
</tr>
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</table>

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A Protected LSD (least squares difference) multiple comparison test revealed a significant difference between the R/D and AI remedial procedures, with the AI difference scores being significantly higher, \( F(36) = 2.737, p < .01 \). A comparison between the mean difference scores obtained across the three groups during baseline and each of the two remedial procedures revealed no significant difference between the baseline scores and the scores obtained during either remedial treatment. The students obtained higher mean difference scores during the AI treatment than during the R/D treatment, but these scores were not significantly different from the baseline measures.

An analysis of the interaction between the two factors of the design, groups and treatments, revealed a significant A x B interaction at a .01 level of significance, \( F(2, 36) = 3.9 \). Figure 1 presents a graphic representation of the A x B interaction. The graph reveals a disordinate interaction between factors A and B, indicating that the effects of the treatment conditions were inconsistent across the three treatment groups. The main effects of the treatment procedures are clouded by this A x B interaction effect, and cast doubt upon the validity of any conclusions drawn about the main effects of factor B (the treatment conditions). The single outlying point at A_1 B_1 corrupts the otherwise general trend of increasing difference scores across factor B (the baseline and two treatment procedures). In only two of the three groups, groups B and C, were the difference scores higher during the phases
FIGURE 1

Mean Difference Scores of Groups A, B, and C for Baseline, R/D, and AI Conditions

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requiring remediation than during the baseline phase.

Reliability was calculated on all unit tests and on three of the unit quizzes, those of units 1, 3, and 5. The experimenter checked each student's work with an answer key provided by the classroom teacher. The numbers of the questions answered incorrectly by each student were recorded on a separate scoring sheet. A second scorer then graded each student's work with the same answer key, making a red slash mark through the number of each question answered incorrectly. The experimenter then compared his scoring sheet with the test paper of each student. Reliability was computed by dividing the total number of agreements by the sum of the total number of agreements plus the total number of disagreements. Reliability ranged from 97% to 100%, with a mean of 99.1%.

DISCUSSION

The results of the present study indicate that remedial procedures consisting of worksheets designed to remediate specific learning deficits, as revealed by students' performance on quizzes, do not significantly increase the academic performance of students on unit tests covering the same academic material. Neither the R/D practice items, nor the AI worksheets presenting additional instruction on objectives prerequisite to those taught in the mainline instruction, proved to significantly raise the percent correct on a unit test over the percent correct on unit
quizzes, as compared to baseline units in which no remedial work was assigned.

These results are consistent with those found by Merrill (1965) when he provided students with corrective feedback and review statements of previously presented material when they responded incorrectly to a question on a computer-based instructional lesson. Merrill found that the subjects receiving correction and review made no fewer errors on a final test than the subjects who received no such remedial instruction. The results of this study are also consistent with those obtained by Merrill, Barton and Wood (1970), for these researchers also found that a remedial procedure consisting of the presentation of review prerequisite material did not result in fewer errors on a criterion test, as compared to a control group. The AI worksheets of the present study, which also provided students with correction and review material related to items missed on unit quizzes, did not improve the performance of students on criterion unit tests.

Okey, Brown, and Fiel (1972) assessed the effectiveness of a remedial procedure that consisted of the assignment of additional practice exercises to remediate learning problems. This procedure is comparable to the R/D procedure of the present study, for students were required to answer at least two questions similar to each item they answered incorrectly on the unit quizzes. In both studies, no significant difference was found between the groups receiving frequent diagnostic testing and remediation, and the groups receiving regular mainline instruction.
The Fiel and Okey (1975) study was most similar to the present study in procedure, for it compared a control group receiving no remediation to two groups receiving different kinds of remediation, prerequisite skill remediation and remediation involving practice on goal tasks. However, the results obtained by Fiel and Okey differed from those found in this study, for Fiel and Okey obtained a significant difference between the criterion test scores of the two groups receiving remediation and the third group that received no remediation. They concluded that remediation was effective in improving academic achievement of eighth grade students. This conclusion could not be drawn from the results of the present study, for the groups receiving either form of remediation improved no more than the groups receiving no remediation between their unit quizzes and unit tests.

Fiel and Okey also found a significant difference on criterion test scores between the group receiving remediation involving practice items and the group receiving a remedial procedure emphasizing prerequisite skill acquisition. This finding is consistent with the results of the present study, for a significant difference was found between the mean difference scores of the R/D groups and the scores of the groups who received the AI form of remediation. The students receiving additional instruction on prerequisites improved significantly more from their quiz scores to their unit test scores than the students receiving R/D remediation.
No significant difference was found between the mean difference scores of groups A, B, and C. This indicates that regardless of the time of the implementation of each treatment condition, and its length of implementation, the difference scores of each group were not significantly different from the scores of the other two groups. However, a significant A x B interaction was found, indicating that the effects of the treatment conditions were inconsistent across groups A, B, and C. As shown in Figure 1, a disordinal interaction can be seen between the three groups and the three treatment conditions. For group A, the largest mean difference score occurred during baseline, and the smallest during the R/D phases. For group B, the largest difference score occurred during AI, and the smallest during baseline. For group C, the difference scores for the R/D and AI treatment conditions were nearly equal, and the baseline score was smaller than both of them. This evidence of disordinal interaction makes a clear-cut interpretation of the data impossible, for the main effects of the treatment conditions are clouded by this interaction between groups and treatments.

The general trend of the mean difference scores across treatment conditions 1, 2, and 3 is an increasing one, with the exception of the single outlying point at A_1. This point represents the mean difference score of group A during baseline, at the outset of the study. Since group A began the R/D treatment condition on the second phase of the study, the baseline mean
difference point is the result of the scores from a single phase, or instructional unit. Therefore, this outlying point may be inconsistent with the remainder of the data because it was based on a single observation which may have been unrepresentative of the typical functioning of group A under baseline conditions.

A formal statistical analysis of the data obtained in this study indicated that neither type of remedial activity provided for the students significantly improved their performance between unit quizzes and unit tests over the improvement they customarily showed with no remedial assignments. However, the statistical analysis used compared mean group scores rather than individual scores. An informal inspection of the difference scores of each individual subject across the three treatment conditions was performed in order to determine the effects of the remedial procedures upon individual student performance.

A total of 21 students received each type of remedial assignment at least once during the course of this study. Six of these 21 students, or 28.6%, obtained greater difference scores between unit quizzes and the unit test during the phases in which they received either R/D or AI worksheets than during those phases in which they received no remedial assistance. All but four of the 21 students receiving both remedial treatments obtained higher mean difference scores during the AI phases than during the R/D phases of the study. Six students of those receiving remedial work of both types obtained their highest
difference scores during the baseline phases of the study. This means that these students improved less when receiving remedial assignments than when they merely participated in regular classroom instruction. However, five of these six students were members of group A, which obtained extremely high and atypical baseline difference scores compared to groups B and C due to the fact that these scores were based on a single observation.

Several students received only one kind of remedial treatment during the study because their quiz scores were too high (greater than 70%) to require remediation during any of the phases of a particular treatment period. Of the 26 students who were assigned the R/D worksheets at some time during the study, ten, or 38.5%, obtained higher difference scores during R/D phases than during their baseline phases. This means that over one-third of the students in the two classrooms under study improved more from their quiz to their test score when they received R/D worksheet assignments than when they received no such special help. It is interesting to note that none of the students in group A showed higher difference scores during R/D than during baseline phases. However, ten of the sixteen students in groups B and C (62.5%) improved more during R/D phases than during baseline. Once again, the high baseline scores of group A masked the possibly beneficial effects of the R/D treatment.

Nineteen of the 28 students who received the AI remedial assignments obtained higher mean difference scores during AI
phases than during baseline phases. This means that 67.8% of those students who completed AI worksheets improved more with this type of additional instructional material than without any remedial assistance. Once again, group A improved much less than either group B or C relative to their baseline performance, for 44% of group A members obtained higher difference scores during AI phases than during baseline, whereas 78.9% of the members of groups B and C had higher difference scores during AI phases.

Throughout this study, no attempt was made to alter the contingencies placed upon academic work in the classrooms from baseline to the experimental conditions. The students were told that the grades they received on both types of remedial worksheets would be averaged into their 6-weeks report card grade, and it was assumed by the experimenter that letter grades would be a strong enough incentive to encourage the students to complete their remedial work with a high degree of accuracy. Paul Robinson (1972) conducted a study in which he investigated the effects of contingency grading upon the test performance of freshman psychology students. The students were divided into four groups, and the members of two of the groups took weekly tests and a final exam for each unit of study, while the other two groups took only the unit exams. In addition, one group of each pair was told that their test scores would not effect their final course grades, while the other members of the class received their course grade contingent upon their test performance. Robinson found that
there was a significant difference ($p<.01$) between the mean number of correct responses on tests obtained by the groups who received grades contingent upon test performance, and those whose grades were noncontingent. He concluded that final grades were an incentive that could be successfully used to increase in-class academic performance of college students, when the grades were assigned contingent upon student test performance.

In the present study, it is possible that letter grades were not powerful enough to motivate the students to complete their remedial worksheets with a high degree of accuracy. Several students lost their worksheets repeatedly, and the work had to be re-assigned. Some students consistently handed in their completed remedial work with an accuracy of less than 70%, even though they had been given feedback on their answers and asked to correct their errors. A more tangible and immediate incentive, contingent upon performance on the remedial worksheets, might have increased the quality of the students' work, and thereby increased the effect of having completed remedial work on the test scores of each instructional unit. Reiss, Klein, and Reiss (1974) used different levels of desirability of recess activities to increase the percent of arithmetic problems completed correctly by third grade students. Students obtained access to one of three levels of recess activities depending upon their overall accuracy level of arithmetic work for that week, or their percent improvement in accuracy compared to the previous two weeks' performance. Using an ABAB
design, the experimenters found that the mean percent of accuracy for the class on arithmetic problems was 52% and 56% during the two baseline phases, and 79% and 82% during the two experimental phases. Of particular interest is the fact that the seven lowest performers of the class, who had a mean accuracy of 35% during the first baseline phase, increased the quality of their work to 78% correct by the end of the second treatment phase. This study showed that a readily available, convenient, and no-cost incentive awarded contingently upon academic performance could increase the accuracy of that performance, even among the lowest achievers of the class.

Harris and Sherman (1974) investigated the effects of contingencies upon homework completion and classroom performance of sixth grade students in two social studies classrooms. During one experimental condition, students who completed homework assignments with 80% accuracy were permitted to leave school ten minutes early. During a second condition, students were allowed to leave school 15 minutes early contingent upon 80% homework accuracy. A third condition allowed students with 80% correct on their homework to leave school 15 minutes early, but in addition those students who did not achieve the 80% criterion were not allowed to go to recess until they corrected their errors and attained 80% correct. The experimenters found that in all three conditions in which consequences were placed on accurate homework completion, there was an increase in the amount of homework turned
in, the percent correct on homework turned in, and the quality of classroom performance of the students, as compared to a baseline phase in which homework was assigned with no contingencies placed on its completion or accuracy.

In the present study, in which only antecedent conditions to test performance were changed through the assignment of remedial worksheets, the resulting changes in student performance on unit tests were small. Several students performed so poorly on the remedial assignments that they could not have profited from their use sufficiently to improve their performance on related test items. However, results of previous studies indicate that the accuracy of student academic performance can be improved if contingencies are placed on that performance. In order to test for the effects of stimulus conditions on student behavior, perhaps these procedures should be implemented in a setting in which a contingency system is already in operation. If contingencies that have already proven effective in increasing student academic performance are placed on the accuracy and completion of remedial assignments, these remedial activities may be completed at a high level of accuracy, and their true effectiveness in increasing academic achievement can be more accurately assessed.
REFERENCES


Merrill, M. D. Correction and Review on Successive Parts in Learning a Hierarchical Task. *Journal of Educational Psychology*, 1965, 56, 225-234.


APPENDIX

Examples of R/D and AI Remedial Items

Repetition and drill

1) What is chlorophyll?
   a. The process by which plants make food.
   b. A colorless gas in the air.
   c. The green coloring material found in plants.
   d. The outer covering of a woody plant.

2) _________________ is the green coloring material in plants that is necessary for making food.

Additional instruction

Chlorophyll is the green coloring material in plants. It is found in the leaves of the plant. Chlorophyll is needed by the leaves of the plant to make food. Chlorophyll combines with other materials in the process of photosynthesis (food-making).

1) What color is chlorophyll?
2) What color are the leaves of plants?
3) Where is chlorophyll found?
4) What do leaves do for a plant?
5) What is chlorophyll used for?