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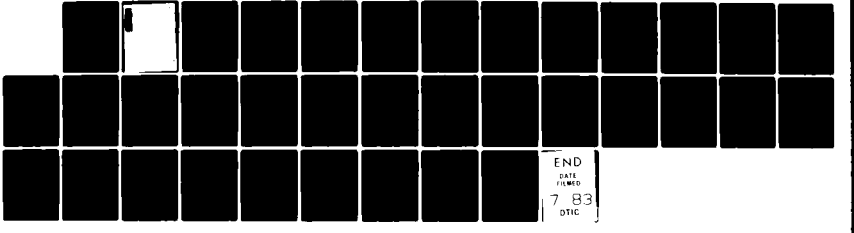

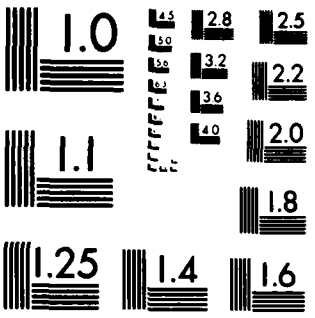

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EFFECTS OF QUESTIONS AND INSTRUCTIONS ON LEARNING FROM TEXT

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Four experiments were conducted to determine if giving students specific instructions about the nature of the textual material and the final test is as effective as giving them practice questions in learning from text. In all experiments, subjects were randomly assigned to one of four groups: (1) a read-only control group, (2) a practice-questions group, (3) an instructions group, and (4) a practice-questions-plus-instructions group. Results of the experiments indicated that (1) instructions can be as effective and,

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in some cases, more effective than practice questions in learning from text, (2) instructions control/focus student processing and attention as well as do practice questions, and (3) the best instructional strategy is a combination of instructions and practice questions.

FOREWORD

This effort was conducted under project ZR000-01-042-06-01.01 (Enhancement of Information Acquisition). The purpose of this project is to provide a greater understanding of the effects of instructional strategies employing instructions and practice questions on student study behaviors.

This report describes a series of experiments conducted to investigate the effects of giving students explicit instructions on learning from text. Results of the research are intended for use by the Naval Education and Training Command.

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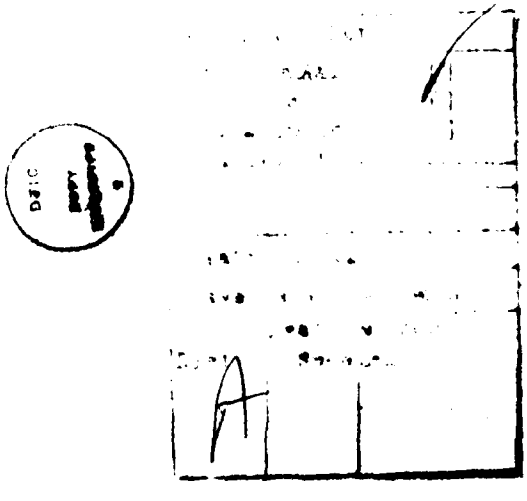

SUMMARY

Problem

Many variables have been shown to facilitate learning from text; for example, giving students advance organizers, practice questions, or behavioral objectives; having them take notes or summarize, etc. However, little information is available as to how these variables affect/control student study behavior; that is, why the effects occur.

Objective

The objective of the current effort was to determine if giving students specific instructions about the nature of the instructional materials and the final test items is as effective or more effective than giving them practice questions in focusing their attention while learning from text.

Approach

Four experiments were conducted that contrasted giving students practice questions with giving them specific instructions about the final test. These experiments were based on the idea that students are actively attempting to discover what is important while they are reading text and that providing them with information on what to study enhances performance. Results of previous studies in which learners have been given instructions suggest that the content of instructions can direct learner attention to important aspects of the materials they are learning and make them more effective learners. Although practice questions can also focus learner attention, they may be less effective because students must infer what is important from the content of the questions.

In all experiments, subjects were randomly assigned to one of four experimental groups: (1) a read-only control group, (2) a practice-questions group, (3) an instructions group, and (4) a practice-questions-plus-instructions groups. In all experiments, tests were developed that included "practice" and "incidental" questions. The former were "practice" only for the two practice-question groups, who answered them after reading their experimental materials. The read-only control and instructions groups had not seen them before.

Results

Experiment 1

The first experiment compared the effect of instructions and practice questions on learning verbatim factual information. Results showed that subjects in the practice-questions groups and in the instructions group performed significantly better than did those in the control group. Incidental questions were answered somewhat better by "instruction" subjects than by "practice-question" subjects.

Experiment 2

The second experiment replicated the procedures of the first. However, the practice and incidental questions were derived by paraphrasing factual information from the text, and instructions on how to study for these questions were given to the two instructions groups. All groups performed significantly better than did the control group. The two practice-questions groups answered the practice questions on the final test somewhat better than did the instruction group.

Experiment 3

The third study replicated the procedures of the first two. In this case, the task involved learning to classify instances of several different categories. Results showed that the practice-questions groups performed better than did the control group on both practice and incidental test questions that required them to classify call signs. The results indicate that, by themselves, instructions about what a classification task is and how best to process the information were not as effective as practice questions and student performance did not differ from that of the read-only control group. Protocols revealed that the instructions had not been well understood by the subjects.

Experiment 4

The fourth experiment replicated the third with revised instructions based on the protocols from experiment 3. Results show that the instructions and practice-questions groups did equally well on practice and incidental questions requiring classification of call signs. All groups did better than the control group.

Conclusions

The results of these studies indicate that (1) instructions can be as effective and, in some cases, more effective than practice questions in facilitating learning from text, (2) instructions, in some cases, more directly control/focus student processing and attention than do practice questions, and (3) a combination of instructions and practice questions is likely to be most effective. More research is needed to investigate how instructions actually work to change or modify the student's studying behaviors. This can be done by looking more closely at the processes the student employs while reading the instructions and studying the materials. Knowing more about what the student is doing and how the instructions affect his/her study behavior will enable instructional designers to be more precise in their prescriptions for writing instructions and for determining what specific kinds of instructions are most appropriate.

Recommendations

1. Students should be given both explicit instructions and questions during both classroom and individualized instructional situations.

2. It is recommended that instructions provided in the appendix be used with the appropriate instructional content.

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INTRODUCTION

Problem

Many variables have been shown to facilitate learning from text; for example, giving students advance organizers, practice questions, or behavioral objectives; having students take notes or summarize, etc. However, little information is available as to how these variables affect/control student study behavior; that is, why the effects occur.

Background

Many experiments have investigated the effects of practice questions on learning. Anderson and Biddle (1975) and Rickards (1979) provide good summary reviews. In the typical study, the performance of one or more groups receiving practice questions is compared to that of a control group receiving no questions. Subjects in all groups are given a reading passage. They are usually not allowed to refer back to the reading material to answer the practice questions; rather, they must rely solely on memory to answer the questions. After completing the passage, all subjects are given a test to assess the effects of the practice questions.

Some of the more interesting findings occur in studies of practice questions that follow text passages (practice post-questions) as opposed to studies of questions that precede text passages (practice pre-questions). Practice post-questions can have two types of effects: (1) a "direct effect"; that is, post-question groups perform better than a read-only control group on final test questions that are informationally similar or identical to the practice post-questions, and (2) an "indirect effect," where subjects receiving post-questions perform better than control subjects on final test questions that are unrelated or incidental to the practice questions (Anderson & Biddle, 1975; Rothkopf & Bisbicos, 1967). The indirect effect is important because it shows that practice questions that follow sections of instructional materials can help the student learn information other than that covered in the questions.

Many investigators have hypothesized that the indirect effect occurs because the practice questions focus the student's attention on the type of question (e.g., factual, application) and/or type of information (main ideas or details such as dates, places, names, etc.) that will be included on the final test (Anderson & Biddle, 1975; Rothkopf, 1966). Focusing is hypothesized to occur in two ways. First, the practice post-questions can alert the student as to the type of information to study. This is called the "forward effect," and results in increased attention to the text following the questions (McGaw & Grotelueschen, 1972). Second, if it is assumed that students mentally review what they have just read to answer practice post-question, they might also review, and perhaps learn, material in the topico-spatial neighborhood of the directly questioned material. This is called the "backward review effect" (McGaw & Grotelueschen, 1972; Rickards & DiVesta, 1974; Rothkopf & Billington, 1974).

The notion that questions focus attention follows from the assumption that students in a learning situation form hypotheses about what is important to study, and that practice post-questions facilitate this process by focusing students' study behaviors and information processing (cf. Andre, 1979). Thus, practice post-questions have a "mathemagenic" effect because students use them to "figure out" what the final test will be like (Rothkopf, 1966; Rothkopf & Bisbicos, 1967).

Brown, Campione, and Day (1981) support the ideas that students actively attempt to discover what is important while reading text and that providing information about what

to study enhances performance. They studied the effects of instructions and training designed to improve students' self-control and self-awareness of their own learning processes. They found that students learned more effectively when they were provided with instructions and training on how to study certain types of material and on how to monitor and control their study activities than when they did not receive instructions. Brown et al. (1981) concluded that students cannot help but become more effective learners if they are made aware of (1) basic strategies for reading and remembering, (2) simple rules of text construction, (3) differing demands of a variety of tests to which their information may be put, and (4) the importance of activating any background knowledge that they may have.

Further support for the hypothesis comes from Mayer and Bromage (1980) in their studies involving advance organizers. They found that a group that received a conceptual advance organizer before reading the text scored higher in recall of conceptual ideas, recalled more incidental material, and made more novel inferences on a recall test than did a group that received the advance organizer after reading the text. In terms of the present discussion, the advance organizer provided the students with "clues" about the nature of the final test and focused their study strategies and behaviors.

Duell (1974) provides some support for the hypothesis that giving students information about what is important to study facilitates learning. She provided some students with detailed behavioral objectives that directed them to learn concepts, names, dates, and definitions presented in the text; and other students, with a nonbehavioral objective that stated that they would be given a multiple-choice test after the reading. After all students had read the text passage and completed the test, they were asked to classify each test item as important or unimportant. The items classified by all subjects as unimportant tested recall of names and dates, and those classified as important tested recall of concepts and definitions. Duell found that students who received detailed behavioral objectives performed significantly better than did students who received a nonbehavioral objective on unimportant questions but not on important questions. She concluded that other strategies for focusing student study behavior may operate in a similar manner (i.e., by setting off information needed when the learner is tested and ensuring that the learner is aware of this relationship).

Finally, Rothkopf (1966), in an investigation of practice questions, compared the performance of a group who received specially prepared care-inducing instructions with that of practice-question groups and a control group. The instructions included statements that the reading material contained much detailed factual information and that the text should be read carefully and slowly. The results, which showed that the instructions group performed better than did a control group, support the notion that instructions can facilitate performance.

Objective

The objective of the present effort was to determine if giving students specific instructions about the nature of the instructional materials and the final test items is as effective or more effective than giving them practice questions in focusing their attention while learning from text.

APPROACH

In the present effort, four experiments were conducted that contrasted giving students practice questions with giving them specific instructions about the final test.

The experiments are based on the idea that students are actively attempting to discover what is important while they are reading text and that providing information about what to study enhances performance. This enhancement should occur because instructions are "explicit," while practice questions are "implicit." By "explicit," it is meant that the instructions are not vague or ambiguous; rather, they provide the student with essential information about the nature of the test and how best to process the information. By "implicit," it is meant that the student must induce what the test will be like from the type of questions asked during instruction. If the student forms a wrong hypothesis or concludes that only the information covered in the questions is important, performance on incidental questions may not improve. This is hypothesized to be the reason that incidental effects are not found with practice prequestions (Anderson & Biddle, 1975). On the other hand, if the student can be given explicit information about what the test will be like before studying, and about how best to "process" the information that is to be learned, test performance should improve.

Results of recent studies (e.g., Brown et al., 1981) on the performance of students who have received instructions suggest that the content of instructions can direct their attention to important aspects of the materials they are learning and make them more effective learners. Although practice questions can also focus student attention, they may be less efficient because students must infer what is important from the content of the questions. Therefore, the problem is to determine if giving students explicit instructions is as effective or more effective as an instructional strategy than giving them questions.

EXPERIMENT 1

The first experiment compared the effects of instructions and practice questions on learning verbatim factual information from text.

Method

Subjects and Materials

Subjects, 80 San Diego State University students enrolled in a class on Introductory Psychology, were randomly assigned to four groups of 20 each: (1) a read-only control group, (2) a practice-questions group, (3) an instructions group, and (4) a practice-questions-plus-instructions group. The 1552-word experimental passage concerned animals and minerals found in the ocean, and was taken from Rachel Carson's (1951) The Sea Around Us. It was composed of a series of factual segments and was divided into 10 sections.

A test was developed that included 20 factual questions, written by taking words and phrases verbatim from the passage. There were two questions from each section: a "practice" question, which would be practice only for the practice-questions and the practice-questions-plus-instructions groups, and an "incidental" question, which would not be seen by any of the groups until they took the test. Sets of acceptable answers were generated for each question for use as the scoring key. In the test, the 20 questions were arranged randomly so that the order presented did not correspond to the order of the 10 sections.

The practice and incidental questions were not counterbalanced. Instead, they were pretested on a sample of 20 subjects, who read the material and took the test. The test items were then equated for difficulty and randomly divided into practice and incidental

questions. The mean scores of pretest subjects for practice and incidental questions were 5.49 and 5.57 respectively.

Procedure

As the subjects entered the testing room, they were randomly assigned to one of the experimental conditions. After they had worked through the appropriate materials at their own pace, they took the 20-question short-answer test that required them to recall verbatim factual information presented in the passage. Treatments of the groups are described below:

1. The read-only control group read the 10 sections in the passage and took the 20-question test.

2. After subjects in the practice-questions group had read each section of the passage, they were given the practice question written for that section and instructed to answer it without referring back to the materials. Subjects were monitored to prevent them from referring back to the passage and to see that they followed the instructions. (No subjects were eliminated for failure to follow instructions.) After subjects had completed all of the sections, they took the test, which included the 10 practice questions they had already answered and the 10 incidental questions they had not seen before.

3. The instructions group was given instructions about the final test. These instructions, which were designed to be more explicit and detailed than were Rothkopf's (1966) hortatory instructions, provided specific information regarding the nature of the test and the type of information to be tested, as well as general instructions about how to study the information to be learned. (The instructions are provided in the appendix.) Specifically, subjects were shown a sample passage that was not related to the experimental passage, and then were given two sample questions drawn from it. They were told that the sample questions required simple recall of factual information presented in the passage. Subjects were then given the experimental passage and instructed to study it so that they would be able to answer factual questions. After they had finished each section of the experimental passage, they were given the following reminder: "Remember, you will be tested on the factual material in the text you are reading. Stop briefly and think about what you have just read, then proceed to the next page of the text." When they had completed all of the sections, they took the 20-item test.

4. The practice-questions-plus-instructions group received the sample passage and the sample questions. Also, after they had read each section in the experimental passage, they were given the practice question, followed by the study reminder. They then took the 20-item test, which included the 10 practice questions they had seen before.

Analyses

1. An analysis of variance (ANOVA) comparing the groups on their performance on the practice and incidental questions in the final test was computed.

2. Group mean scores on practice and incidental questions on the final test were compared using a post hoc Newman-Keuls test.

3. Correlations between group mean scores on the incidental and practice test questions were computed.

Hypotheses

It was hypothesized that:

1. If giving students practice post-questions results in mathemagenic effects because such questions help them to anticipate what the final test will be like, then giving them instructions about what the test will be like should also be effective. Specifically, if giving students practice post-questions causes them to focus more on specific content than on the rest of the material, then students receiving instructions would perform better than would students receiving practice post-questions. Although both practice and incidental questions were new for the students given instructions (and for students in the control group), the instructions had been developed to apply, in general, to factual questions.

2. Students receiving practice post-questions should perform better on the practice questions when they are repeated on the test than those not receiving practice post-questions.

3. Students that receive both instructions and practice post-questions should perform best on the practice and incidental test items.

Results and Discussion

ANOVA results showed that there was a significant main effect for groups ($F(3,76) = 6.99$, $p < .001$, $MSE = 5.22$) and for test question type (practice or incidental) ($F(1,76) = 9.96$, $p < .002$) as well as a significant test-question-type-by-groups interaction ($F(3,76) = 5.08$, $p < .002$, $MSE = 1.50$). Table 1 presents means and standard deviations (SDs) for each group on the number of incidental and practice test questions answered correctly. Note that there was little difference in performance on the practice and incidental test items for the read-only control and instructions groups. This confirms that the practice and incidental item sets were equally difficult.

Table 1

Group Mean Scores and Standard Deviations on Practice and Incidental Test Questions--Experiment 1

	Test Question Type				
	Practice[a]		Incidental		
Group	Mean[b]	SD	Mean[b]	SD	Total
Read-only control	5.85	1.72	5.55	2.28	11.40
Instructions	6.85	1.38	7.30	1.52	14.15
Practice-questions	7.35	1.75	6.30	2.27	13.65
Practice-questions-plus-instructions	8.80	1.23	7.25	2.12	16.05

[a]Questions were practice only for the practice-questions groups.

[b]Based on a maximum score of 10.

The Newman-Keuls comparison of group means for practice questions on the final test revealed that the performance of the practice-questions-plus-instructions group was significantly higher than that of all other groups ($p < .05$). Apparently, the combination of instructions and practice post-questions has a cumulative effect on performance. Furthermore, the performance of the practice-questions and instructions groups differed significantly from that of the read-only control group ($p < .05$). This finding illustrates the "direct effect" of practice post-questions and shows that instructions had a similar effect. The finding that instructions were as effective as practice post-questions on this measure was contrary to expectations. It could be that instructions are more effective than initially hypothesized or that practice questions are less effective because of their implicit nature. The findings for the practice-question-plus-instructions group favor the latter explanation.

The Newman-Keuls comparison of group means for incidental questions on the final test showed that the performance of the practice-questions-plus-instructions and the instructions groups differed from that of the read-only control group ($p < .05$), but not from each other. In addition, the performance of the practice-questions group did not differ from that of the read-only control group. This finding is inconsistent with that of Rothkopf and Bisbicos (1967), who found that restricted categories of questions (e.g., names, scientific or technical words, distance, etc.) facilitated learning of restricted categories of text content. However, the practice questions used in this study required recall of general factual information rather than recall of restricted categories. Although the difference between the performance of the practice-questions and the instructions groups was only marginally significant ($p < .10$), it is supported by the significant group-by-test-question-type interaction.

Finally, the correlations between performance on the incidental and practice test questions for the read-only control, instructions, practice-questions, and practice-questions-plus-instructions groups were .51, .64, .55, and .66 respectively, all significant at the .05 level. These data indicate that performance on the practice and incidental test questions was significantly related in all treatment groups.

The results of this experiment support the hypothesis that giving students instructions about the final test can be as effective as, and, in some cases, more effective than, practice questions in focusing attention and study behaviors on verbatim factual material.

EXPERIMENT 2

The second experiment was a replication and extension of the first. However, paraphrased-comprehension questions (Anderson, 1972) were used instead of verbatim questions because it has been shown that such questions given during instruction can improve test performance (Andre & Sola, 1976; Andre & Womack, 1978). This finding suggests that leading students to process what they read produces greater comprehension of and learning from instructional materials. Because paraphrase questioning has been found to be a useful instructional strategy, the intent of this second experiment was to determine whether explicit instructions could be written to enable students to prepare effectively for paraphrase test questions; that is, could giving students instructions alone be as effective as giving them paraphrased practice post-questions?

Method

Subjects and Materials

Subjects, 87 Navy enlisted men, were randomly assigned to four groups: a read-only control group, a practice-questions group, an instructions group, and a practice-questions-plus-instructions group. The 2281-word experimental passage concerned the history of submarine warfare, and was taken from the Naval Orientation Manual (NAVPERS 16138.F). It was divided into 13 sections.

A test was developed that included 26 questions written by paraphrasing statements in the reading passage according to Anderson's (1972) rules and techniques. They required the student to recall factual information presented in the materials and contained no repetition of key words or phrases that could act as memory cues. As before, there were two questions--practice and incidental--from each section, which were counterbalanced. The first section of the passage and the two paraphrased questions written for it are illustrated in Figure 1.

Submarine Warfare

The first submarine to enter combat was invented in 1776 by an American, David Bushnell. Revolutionary in every sense of the word, Bushnell's Turtle made a submerged attack on a British warship in New York Harbor. Operated by a hand-worked propeller, her tanks flooded by a valve and emptied by a hand pump, the Turtle encountered overpowering difficulties and her maiden foray was ridiculed as a failure. Not until after the war was it known that Bushnell's undersea boat worried the British into moving their blockading warships from New York Harbor to the outer bay.

1. The effect of the Turtle's presence on British combat strategy was to remove blockading warships.

2. The primary reason for the Turtle's failure to complete its mission was unreliable submersion equipment.

Figure 1. Example passage and two paraphrased questions.

Procedure

The procedure was the same as that used in the first experiment except that the directions given to the instructions group differed from those given in the first experiment. This time, subjects in the instructions group were given a 264-word sample passage and were told that it was similar to the experimental materials they were about to read and that test questions would use different words that described the same ideas. They were told to study the experimental passage so that they could understand the main facts presented. (The instructions are provided in the appendix.) After they had completed each of the 13 sections, they were given the following study reminder: "Remember, you will be tested on factual information found in the text. Because the wording in the questions will be different, you should study so that you understand the main facts presented in the passage."

For each subject, the following data were collected: (1) time to complete the study materials, (2) time to complete the test, and (3) scores on the practice question and incidental questions of the final test. The short-answer responses were scored by four judges, with questionable responses being resolved by group consensus.

Analyses

1. ANOVAs were computed comparing the groups on (a) the time required to complete the study materials, (b) the time required to complete the test, and (c) scores obtained on the practice and incidental test questions.

2. Group mean scores on practice and incidental questions on the final test were compared using a post hoc Newman-Keuls test.

3. Correlations between group mean scores on the incidental and practice test questions were computed.

Results and Discussion

The ANOVA comparing groups on time required to complete the experimental materials showed a singificant main effect for groups (F (3,83) = 16.92, $p < .001$). The average time needed to complete the materials for the read-only control, instructions, practice-questions, and practice-questions-plus-instructions groups were 18.0, 18.6, 24.8, and 28.2 minutes respectively. The ANOVA comparing groups on time to complete the final test showed no significant differences among groups. It is clear that the introduction of practice post-questions lengthens study time but not test time.

The ANOVA comparing groups on the number of correctly answered practice and incidental final test questions showed significant main effects for group (F (3,83) = 6.64, $p < .001$, MSE = 6.48) and for test question type (F (1,83) = 5.52, $p < .002$, MSE = 2.64), and a significant group-and-test-question-type interaction (F (3,83) = 14.91, $p < .001$). Table 2 presents the means and SDs for each group.

Table 2

Group Mean Scores and Standard Deviations on Practice and Incidental Test Questions--Experiment 2

	Test Question Type				
	Practice[a]		Incidental		
Group	Mean[b]	SD	Mean[b]	SD	Total
Read-only control	7.33	2.84	7.35	2.51	14.68
Instructions	8.09	2.27	9.88	1.51	17.97
Practice-questions	9.70	1.78	8.04	1.68	17.74
Practice-questions-plus-instructions	10.97	1.57	8.50	2.52	19.47

[a]Questions were practice only for the practice-questions groups.

[b]Based on a maximum score of 13.

The Newman-Keuls comparison of group means for the practice questions on the final test revealed that the performance of the practice-question and the practice-question-plus-instructions groups differed from that of the instructions and the read-only control groups ($p < .05$). These data indicate that practice post-questions are more effective than instructions for material covered by the practice questions. This finding differs slightly from the results of the first experiment. A possible explanation for the superior performance of the practice-questions group on the practice questions of the final test in this experiment is that the paraphrased practice post-questions in the experimental materials were repeated on the final test. In the first experiment, all subjects saw the same words because the questions were taken verbatim from the text.

The Newman-Keuls comparison of group means on the incidental questions of the final test showed that the performance of the instructions and the practice-questions groups differed significantly from that of the read-only control group ($p < .05$) but not from that of the practice-questions-plus-instructions group. These data also support the hypothesis that explicit instructions about how to study for comprehension can be as effective as practice questions in focusing attention and study behavior on incidental material. An interesting finding is that the performance of the practice-questions-plus-instructions group does not differ from that of the read-only control group on the incidental test questions. A possible explanation for this result is that the presence of the instructional reminder with the practice question may have caused the subjects to focus exclusively on the practice question and how it was paraphrased. Some support for this interpretation comes from the finding that the practice-questions-plus-instructions group spent the most time on the experimental materials. Further support for the overfocusing interpretation is provided by the correlation computed between performance on the practice and incidental test questions in each treatment group. The correlations for the read-only control, instructions, practice-questions, and practice-questions-plus-instructions groups are .48, .38, .49, and .21 respectively. All correlations were significant except that for the practice-questions-plus-instructions group, which indicates that this group's performance on the practice test items was not related to its performance on the incidental test items. Note that the performance of this group did differ from that of the read-only control group in experiment 1 and that the correlation for that group was significant. This overfocusing might have been avoided by informing the students that the test would cover more than just the practice questions.

EXPERIMENT 3

The third experiment examined the effects of explicit instructions and practice questions on learning a conceptual classification task from text. Classification tasks involve categorizing, sorting, or identifying objects, events, or things according to the category in which they belong based on their common characteristics. Classification tasks are higher-order or transfer tasks because they require subjects to deal with things or events not previously encountered. The intent of this experiment was to determine whether explicit instructions could be written to enable students to learn a classification task effectively.

Method

Subjects and Materials

Subjects, 279 Navy enlisted personnel, were randomly assigned to four groups: (1) a read-only control group, (2) a practice-questions group, (3) an instructions group, and (4) a practice-questions-plus-instructions group. The 657-word experimental passage was a

lesson on Navy radio call signs, which are used by radio stations to identify themselves (e.g., WABC or KCBA). The passage was divided into four sections, covering five types or classes of Navy call signs.

A 24-item short-answer test was developed that required subjects to classify four call sign instances from each of the five call sign types and four call signs that were not valid Navy call signs. Twelve of the 24 call signs were used as practice questions. The practice and incidental call sign examples were counterbalanced.

Procedure

The subjects were randomly assigned to one of the experimental conditions. After they had worked through the appropriate materials at their own pace, they were required to classify the 24 call signs based on their common characteristics. Treatment of the groups is described below.

1. The read-only control group read the passage and took the test.

2. Practice-questions group subjects were told that they would be required to answer questions after they had completed each of the four sections but they did not receive details as to the type of questions or study strategy. After they completed each section, they were given three call signs to classify and instructed to do so without referring back to the experimental materials. After they had completed the four sections, they took the test, which included the 12 call signs they had classified previously as practice questions and 12 other call signs, used as incidental questions that they had not classified before.

3. The instructions group was given explicit instructions; that is, a presumably effective study strategy for the present type of material, a definition, and examples of classification tasks. Subjects were told to study the experimental passage so that they could identify the critical features of the categories described therein and distinguish among them. After they had completed each of the four sections, they were given the following study reminder: "Remember, on the test you will be asked to classify a variety of call signs. There are several types of call signs that can be classified according to different characteristics. You should think about the characteristics of the type of call sign you just learned." When they had completed all sections, they took the test requiring them to classify 24 call signs, none of which they had classified before.

4. The practice-questions-plus-instructions group received the same instructions provided the instructions group. After they had finished each section, they were given the practice questions (three call signs to classify), followed by the study reminder. When they had finished all of the sections, they took the test requiring them to classify 24 call signs, 12 of which they had classified as practice questions and 12 that they had not classified previously.

Analyses

A 2 (instructions vs. no instructions) by 2 (practice questions vs. no practice questions) by 2 (practice test question vs. incidental test question) analysis of covariance with the first two factors between groups and the third factor within subjects was performed on the number correct on practice question/incidental question subtest of the final test. Subjects' Armed Forces Qualification Test (AFQT) scores were used as a covariate.

Results and Discussion

The analysis of covariance for test scores showed a significant main effect only for practice questions (F (1,274) = 14.89, $p < .001$). Means and SDs for each group on the number of incidental and practice call signs classified correctly are presented in Table 3.

Table 3

Group Adjusted Mean Scores and Standard Deviations on Practice and Incidental Test Questions--Experiment 3

	Test Question Type				
	Practice[a]		Incidental		
Group	Mean[b]	SD	Mean[b]	SD	Total
Read-only control	8.96	2.89	8.88	3.00	17.84
Instructions	9.38	2.64	9.36	2.74	18.74
Practice-questions	10.37	2.03	10.34	2.13	20.71
Practice-questions-plus-instructions	10.29	2.38	10.21	2.43	20.50

[a]Questions were practice only for the practice-questions groups.

[b]Based on a maximum score of 12.

These data indicate that instructions describing a classification task and how best to process the information were not as effective as were practice questions. Further, the performance of the instructions group did not differ from that of the read-only control group on the final test. It is interesting to note, however, that performance on the practice and on the incidental test questions did not differ for any of the groups. A possible explanation for this result is that good performance on categorization tasks does not depend on memory for specific items of information but, rather, on memory for the defining characteristics of the category.

Because these results conflict with the results of the first two experiments, structured protocols were taken on seven students while they read the materials given to the instructions group. The structured protocols consisted of questions designed to determine what affect the instructions had on classification task learning. Students were questioned after they read the instructions, when they were learning the materials, and after they completed the final test. In general, the questions concerned the students' awareness of what the test would be like and how best to study. After reading the instructions, only one student could accurately predict what the test would look like. During the learning period, two more students accurately described the final test. Finally, after completing the final test, five students reported that they would have studied differently had they seen the test questions in advance. These data help explain why the performance of the instructions group subjects did not differ from that of the read-only control group subjects. Apparently, subjects in these groups did not correctly

anticipate the final test, whereas subjects in the practice-questions groups saw actual test questions and presumably adjusted their study behavior accordingly.

EXPERIMENT 4

For the fourth experiment, the instructions were refined to include (1) examples of classification tasks and (2) instructions on how classification tasks are tested and how to study for a classification task.

Method

Subjects and Materials

Subjects, 72 Navy enlisted personnel, were randomly assigned to four groups: a read-only control group, a practice-question group, an instructions group, and a practice-questions-plus-instruction group. The 657-word experimental passage was a lesson on five classes of Navy radio call signs, which was divided into four sections, covering five types or classes of Navy call signs.

A 24-item short-answer test was developed that required subjects to classify four call sign instances from each of the five call sign types and four call signs that were not valid Navy call signs. Twelve of the 24 call signs were used as practice questions. The question and incidental call sign examples were counterbalanced.

Procedure

After the subjects had worked through the appropriate experimental materials at their own pace, they were given the final test. The groups were treated as follows:

1. The read-only control group read the passage and took the test.

2. After the practice-questions group subjects had completed each section, they were given three call signs to classify and instructed to do so without referring back to the materials. After they had completed the four sections, they took the test, which included the 12 call signs they had classified previously as practice questions and 12 other call signs, used as incidental questions.

3. The instructions group was given explicit instructions about what and how to study for a classification task. Subjects were told to study so that they could identify the critical features of the categories described in the passage and distinguish among them. (The instructions are provided in the appendix.) After they had completed each of the four sections, they were given the following study reminder: "Remember, on the test you will be given several call signs. For each one, you will have to write the name of the type of call sign it is next to it. You should try to remember the characteristics of the type of call sign you just learned as well as the name of the type." When they had completed all sections, they took the test requiring them to classify 24 call signs, none of which they had classified before.

4. The practice-questions-plus-instructions group received the same instructions given the instructions group. After they had finished each section, they were given the practice questions (three call signs to classify), followed by the study reminder. When they had finished all the sections, they took the test requiring them to classify 24 call signs, 12 of which they had classified as practice questions and 12 that they had not classified before.

Analyses

1. Analyses of covariance were performed on the time required to complete the experimental materials and on the time required to complete the final test.

2. A 4 (group) by 2 (practice test question vs. incidental test question) analysis of covariance with the first factor between subjects and the second factor within subjects was performed on the number correct on practice incidental questions on the final test. Subjects' AFQT score was used as a covariate.

3. Group mean scores on practice incidental questions on the final test were compared using a post hoc Newman-Keuls test.

Results and Discussion

A significant main effect for group was found for the analyses of covariance performed on the time to complete the experimental materials (F (3,67) = 3.75, $p < .01$), on the time to complete the final test (F (3,67) = 3.53, $p < .01$) and on the number correct on practice/incidental questions on the final test (F (3,67) = 4.33, $p < .01$). Group means for required completion times and for test scores are presented in Tables 4 and 5 respectively.

Table 4

Group Mean Completion Times--Experiment 4

	Completion Times (Min.)	
Group	Experimental Materials	Final Test
Read-only group	9.33	11.44
Practice-questions	12.72	8.22
Instructions	11.05	7.66
Practice-questions-plus-instructions	12.77	7.77

Table 5

Group Adjusted Mean Scores and Standard Deviations on Practice and Incidental Test Questions--Experiment 4

Group	Test Question Type: Practice[a] Mean[b]	Practice SD	Incidental Mean[b]	Incidental SD	Total
Read-only control	6.28	3.28	6.45	2.95	12.73
Instructions	8.23	3.79	8.45	3.48	16.68
Practice-questions	8.47	2.81	8.47	2.81	16.94
Practice-questions-plus-instructions	9.94	1.83	9.61	1.84	19.55

[a]Questions were practice only for the practice-questions groups.

[b]Based on a maximum score of 12.

It should be noted that the group mean scores in this study were generally higher than those in the third experiment, even though some of the groups received identical treatments. The reason for this is that the AFQT scores for subjects in experiment 3 were significantly lower ($p > .001$) than those for subjects in the present experiment.

As in experiment 3, group performance on practice questions and incidental questions on the final test did not differ. Again, an explanation for this result is that good performance on categorization tasks does not depend on memory for specific items of information but, rather, on memory for the category name and its defining characteristics.

The Newman-Keuls comparison of group means for both practice and incidental questions on the final test revealed that the performance of the read-only control group differed significantly ($p < .05$) from that of the other groups. These data indicate that the instructions were as effective as practice questions in facilitating learning.

CONCLUSIONS

In general, the instructional implications of these results are that students should be told explicitly what to expect on the test, as well as given practice questions. Although the strategy that would promote the most learning for factual material would be to include practice questions for every item to be tested, this approach is usually impractical. The strategy of giving instructions plus practice questions should allow students to concentrate more broadly on all information relevant to the final test rather than focusing on the portion of the content covered by the practice questions. However, experiment 2 revealed that providing the learner with instructions about paraphrased practice questions as well as the practice questions appeared to overfocus the student's attention on the practice questions. This overfocusing is demonstrated by the poor performance of the practice-questions-plus-instructions group on the incidental test

items. A possible strategy for preventing overfocusing would be to develop more explicit instructions about the nature of the test and how to study for it.

The results of these studies indicate that instructions can be as effective and, in some cases, more effective than practice questions in facilitating learning from text. In addition, protocols and time measures indicate that instructions more directly control/focus student processing and attention. Finally, a combination of instructions and practice questions are likely to be most effective. More research is needed to investigate how instructions actually work to change or modify the student's studying behaviors. This can be done by looking more closely at the processes the student employs while reading the instructions and studying the materials. Knowing more about what the student is doing and how the instructions affect his/her study behavior will enable instructional designers to be more precise in their prescriptions for writing instructions and for determining what specific kinds of instructions are most appropriate.

RECOMMENDATIONS

1. It is recommended that students be given both explicit instructions and questions during instruction. Questions and instructions should be given in both classroom and individualized instructional situations.

2. It is recommended that instructions provided in the appendix be used with the appropriate instructional content.

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APPENDIX

INSTRUCTIONS USED IN THE EXPERIMENTS

EXPERIMENT 1

1. Factual Instructions:

Before reading the text, you will find a sample passage. Read through these paragraphs and then try to answer the questions that follow, to yourself, without going back to the passage. Turn the page to check your answers. The sample passage is to help you to determine the type of information you will be expected to remember in the experimental text that follows.

2. Sample Passage:

Action is the basis of the initial knowledge acquired by the child. Through his actions, the infant can evolve general concepts of the things he encounters: His concept of a dog could be based on the feel of its hair and the funny noises it makes when pinched; his concept of a ball could be based on its behavior when thrown. In the absence of language, perceptual and cognitive structures can be built up out of the actions of his experiences.

These early structures contain the sequences of actions taken by a child in dealing with his environment. The development of these schemes for action integrates sensory events with motor movements in what is called a sensorimotor schema. The various sensorimotor schemata learned by the child in his first 2 years, plus the knowledge he then has of the permanence and independence of objects and events, comprise the base upon which language is established.

Language develops within this framework of sensorimotor intelligence. Initially, the problem of learning a language may mainly be that of assigning linguistic labels--names--to the already existing sensorimotor schemata. The child first begins to use language to label the things with which he is already familiar--his toys, his family, the objects in his environment. He also labels his actions as he performs them.

Answer these questions to yourself. Then turn the page and check your answers.

Questions:

a. What is the basis of the initial knowledge acquired by the child?

b. What is the schema for integrating sensory events with movement called?

c. What is the initial problem involved in learning a language?

Note. During the actual experiment, each part of the instructions was presented separately.

Answers:

a. Action.

b. A sensorimotor schema.

c. Assigning names to objects.

3. Reminder (Given after subjects read each section of experimental passage):

Remember, you will be tested on the factual material in the text you are reading. Stop briefly and think about what you have just read, then proceed to the next page of text.

EXPERIMENT 2

1. Paraphrased Instructions:

Before reading the text, you will find a warm-up passage and sample questions. The purpose of this warm-up passage is to illustrate the kinds of questions you will be asked on the test. You will notice that the questions ask for factual information that was contained in the sample passage. The questions will not use the exact words that were used in the sample passage but, instead, will use different words that describe the same ideas. Because the wording in the questions will be different, you should study so that you understand the facts presented in the passage.

Turn the page and read the warm-up passage. When you have finished reading, answer the practice questions. Please note how the wording in the questions is different from the wording in the passage.

2. Warm-up Passage:

In the Civil War, control of the sea was important and even decisive--and it was overwhelmingly in the hands of the North. For 4, years the Union Navy was constantly occupied with the task of blockading more than 3000 miles of coastline, running down Southern commerce raiders, cooperating with the Army in capturing coastal strongholds, and opening the Mississippi and other waterways that led into the South. The South countered with commerce raiders, but the strangling effect of the Union blockade eventually took its toll. It crippled the finances of the Confederacy, shut out foodstuffs and munitions, and proved a major factor in deciding the outcome of the war. The country learned, or should have learned, from this war that a navy could not be quickly and readily improvised in an emergency. Even then, the days were past when merchant vessels could be converted rapidly into efficient men-of-war.

When the Spanish-American War broke out, it was at once recognized that the conflict would be primarily naval and would be won by the nation that secured control of the sea. The paper strength of the two navies was about equal, but the Spanish Navy was characterized by poor equipment, incompetence, and lack of trained personnel. Both at Manila Bay and Santiago the enemy's fleet was destroyed. Although Dewey's victory at Manila Bay had little material effect on the war, the destruction of Admiral Cervera's ships off Santiago, Cuba, established the Navy's command of the Caribbean.

Answer the sample questions and then turn the page to check your answers.

Questions

a. During the war between the states, Yankee strategy for using their ships to the best advantage centered on _____.

b. One of the lessons that was taught in the Civil War was that it took time to ___ _____.

c. When the war between the U.S. and Spain began, it quickly became clear that the victor would be whichever country _____.

Note. During the actual experiment, each part of the instructions was presented separately.

Answers:

a. Blockading the coastline.

b. Build a Navy.

c. Controlled the sea.

Notice that the questions above asked for factual information that was contained in the warm-up passage. The questions did not use the exact words that were in the sample passage, but, instead, used different words that described the same ideas.

3. Reminder (Given after subjects read each section of experimental passage):

Remember that you will be tested on factual information found in the text. Because the wording in the questions will be different, you should study so that you understand the main facts presented in the passage.

EXPERIMENT 4

1. Classification Instructions:

In this experiment, you will learn about a classification task. Here, we will tell you what classification tasks are, and how to study for them.

Classifications refer to groups or categories of similar things. The things in each category are similar because they have certain special characteristcs in common. Classification tasks involve categorizing or sorting or identifying things according to which category they belong in. This is done on the basis of the special characteristics the things have. In order to classify things into the right category, you need to remember the special characteristics that define each category and the name of each category.

Examples of Classification Tasks:

The first example is political parties. If you know a person's political views on some issues, you should be able to classify the person as a Republican, Democrat, Independent, etc. To do this, you need to know what the names of the parties are and the characteristic political views associated with each party. For example, Republicans (the name) believe in free enterprise, less government, and a strong military (the characteristics). If you met a person who believed in free enterprise, a strong military, and less government, you would classify that person as a Republican.

The second example of a classification task is also a familiar one. It has to do with automobiles and their makes or models. You can probably identify a car as a Buick, Chevrolet, Volkswagen, etc. You can do this because you know the names of different types of cars, and because you know what characteristics to look for to help you decide what make a car is. For example, if you saw a car with three holes on the front fenders, you would need to know that these holes are characteristic of a particular type of car, and the name of that type--a Buick.

Finally, a third example of a classification task is identifying types of wood. Carpenters are able to classify and sort various types of wood according to such special characteristics as grain, texture, and color. Carpenters know these characteristics for many types of wood, and they know the name of each type. For example, if we gave a carpenter a piece of reddish straight-grained, soft wood, he would know that these characteristics are typical of a particluar type of wood, and he knows the name of that type--Redwood.

How are Classification tasks Tested?

Classification tasks are usually tested by giving the student an example from some category, and asking the student what the name of the category is. To do this, the student needs to know the characteristics of different categories, and he needs to remember the names of each of the categories. For example, to test whether someone

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Notes.

1. Instructions given here were revised from those used in experiment 3.

2. During the actual experiment, each part of the instructions was given separately.

could identify cars, we would give a series of pictures of cars and ask the student to give the name of each car. To test whether someone could identify different types of wood, we would give pieces of wood and ask the student to give the names of the type of wood for each piece. Examples of classification tests are as follows:

a. A typical classification test has directions like this:

"Here is a list of things. Write the name of each one in the space provided next to each one."

b. Here is a test for the task of classifying cars:

"Directions: Here is a series of pictures of cars. Write the name or model of each car next to its picture.

(picture 1) _____

(picture 2) _____

(picture 3) _____

etc."

c. Here is a test for the task of identifying political parties:

"Directions: Here is a list of different peoples' political views. Next to each one, write what party *you think the person belongs to.*

(1) Fred believes in less government, a strong military, and free enterprise.

Fred is a _____

(2) Alice believes in big government, consumer protection, more welfare instead of defense spending.

Alice is a _____

etc."

How to study for Classification Tasks

Usually, a piece of instruction will give you the name and characteristics for a particular category. For example, a book about cars might say something like "You can always tell a Buick because it has three holes in the front fenders." This sentence tells you both the name (Buick) and the characteristics (three holes in the front fenders). When you study, you have to remember both the characteristics and the name. If you don't remember the name, you won't be able to write it on the test, even if you do remember the characteristics.

2. Reminder (Given after subjects read each section of experimental passage):

Remember, on the test you will be given several call signs. For each one you will have to write the name of the type of call sign it is next to it. You should try to remember the characteristics of the type of call sign you just learned as well as the name of the type.

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