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PhD degree in Educational Psychology

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THE EFFECTS OF COMMUNICATING APPLICATION TASK REQUIREMENTS ON STUDENTS' LEARNING PROCESSES AND ACHIEVEMENT

By

Jun Young Shin

A DISSERTATION

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ABSTRACT

THE EFFECTS OF COMMUNICATING APPLICATION TASK REQUIREMENTS ON STUDENTS' LEARNING PROCESSES AND ACHIEVEMENT

by

Jun Young Shin

Most research on the instructional effects of objectives has shown that objectives clearly communicate instructional requirements for recall tasks more effectively than application tasks. This study asked: How can instructors successfully communicate test requirements through objectives for application tasks learned from text? The researcher derived two qualities of objectives that would be likely to affect student's learning processes and achievement: (a) the definition of the subject matter domain in the objective, and (b) the concreteness of the example of the test task in the objective.

A posttest only control-group experimental design was used. Fifty-six volunteer graduate students were randomly assigned to one of four treatments: objectives that were (a) defined and concrete, (b) defined and not concrete, (c) concrete and not defined, and (d) neither defined nor concrete. Subjects' were asked to read text, select relevant content from text, choose practice exercises, explain their reasons for their selections and take an application task posttest.

Analysis of the data showed that:

1. Subjects presented with defined objectives were able to select relevant content. They used objectives as a guide to limit their choices.

2. Subjects presented with concrete objectives behaved no

differently than subjects without them in selecting the right exercise for preparing for the posttest. They made selections based on the examples in the text as well as the example in the objectives.

3. Students' posttest performance was positively and substantially affected by the defined objective treatment. However, there was an indirect link in the path from the defined objective treatment to the posttest through choosing relevant content and performing well on an exercise.

4. Subjects presented with the defined objective treatment were not different in their reading time than subjects without the treatment.

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Chapter I
INTRODUCTION

Problem

In elementary school, high school, college, and even graduate school, students are often given assignments to learn from a text. They are told to read the text and to do some exercises. In elementary school, a student may be asked to read from a social studies text to find out how to interpret maps. In high school, a student may be asked to read from an art history text to be able to understand art styles. In college, a student may be assigned to read from an economic text to learn how to understand the law of supply and demand. Each of these students must make choices about which content in their text to pay most attention, and given a choice about exercises at the back of the chapter, they must make decisions about which exercise to do. Specifically, they must determine what content in their reading is important and what practice they must do to learn from text. To aid these students in attending to relevant content and in choosing useful learning activities, and thereby to learn more effectively and efficiently, instructors and instructional designers use orienting devices to communicate requirements to students.

One type of orienting device is an instructional objective. An objective is a statement of "what students will be able to do or how they will be expected to behave after completing a prescribed unit of course of instruction (Kibler & Bassett, 1977, p. 55)." An objective includes certain elements such as specific conditions of testing, observable test behavior, definition of criteria, and the lower limits of acceptable performance (Yelon, 1991). For the purpose of this study objectives will contain conditions and behavior. For example, the elementary school teacher may tell students that on the test they will be given a map and will be asked to find distances between two specific locations. The high school teacher may tell students that on the test they will be given an art work and will be asked to state the characteristic of the particular work that fit a certain style of art. The college professor may tell students that on the test they will be given a supply and demand data for one year and will be asked to predict the cost of a product for another year.

In exploring the best ways to orient students via objectives, researchers have found that certain variables best influence their effect. The objectives must be specific and complete, that is, the content must be defined and the task must be presented concretely. (Hamilton, 1985; Melton,1978; Frase & Kreitzberg, 1975; Kaplan & Rothkopf, 1974; Rothkopf & Kaplan, 1972; Yelon, 1991).

A defined course objective is a statement that limits the domain of subject matter clearly. If an objective is defined, students can attend to relevant content from a text because the label assigned to the domain or the attributes of the defined domain are clear. For example, the elementary school teacher might tell students more than: "From this text, you will interpret maps." The teacher might say: "You will learn to calculate the distance between.any two cities on a map." The high school teacher might also tell students more than: "From this text, you will understand styles of art." The teacher might say: "You will learn to identify the art style of impressionists." The college professor might also tell students more than: "From this text, you will understand the law of supply and demand." The professor might say: "You will learn to predict a cost of a particular product."

A concrete course objective is a statement that denotes the referent test clearly. If an objective is concrete, that means it describes the test conditions and behavior clearly, so students can choose appropriate means to prepare for the test because the test situation and performance are clear. For example, within an objective, the elementary school teacher might provide an example of a test question based on the reading such as: "There is a Michigan map, you will calculate the distance between Lansing and Ann Arbor." The high school teacher might provide in an objective an example of a test question based on the reading such as: "Here is a Van Gogh painting you haven't seen before (Starry night). State the characteristics of the painting which make it an impressionistic painting." The college professor might provide in an objective an example of a test question based on the reading such as: "Here is the price of petroleum in 1991. Here is data that show estimated supply and demand of world petroleum for 1993. Predict the cost of the petroleum in 1993."

Researchers have found that it is relatively easy to successfully communicate requirements via objectives for recall tasks such as definitions, facts, and formulas (Duchastel, 1980; Hamilton, 1985; Ho, Savenye, & Haas, 1986; Kaplan & Rothkopf, 1974; Rothkopf & Kaplan, 1972). But, researchers have found that it is difficult to effectively communicate requirements by way of objectives for application tasks

(Barker & Hapkiewicz, 1979; Duell, 1974). An application task is a task in which learners are not merely engaging in rote learning, but attempting to use the idea in new situations. Thus, teachers wishing to teach interpretation of maps, understanding an art work, and understanding of the law of supply and demand need further research to guide their design of the application objectives. Therefore, the main question of this research is: How can instructors successfully communicate requirements through objectives for application tasks to be learned from text? Subsidiary questions are: How can instructors help students to know what to attend to in their text assignments, and to know which learning exercise to select?

This was a study for exploring the relationship among the three major factors: (a) communication of test requirements via objectives for application tasks to be learned from text, (b) students' cognitive learning processes as they use objectives to learn from text, and (c) student achievement of application tasks learned from text. An experimental research design supplemented with questionnaires was used. Fifty-six graduate students participated and were asked to learn a statistical application task from text. The experimental protocol attempted to simulate a typical reading assignment. The students were first given objectives with varying characteristics, the degree to which they were defined and concrete. Second, subjects were given a text selection to read. Third, subjects were given a choice of practice exercises similar to those at the end of a reading.

Research Questions

The following questions served as a framework for the study:

Question one: Will students presented with the defined objective treatment be able to select more relevant content than students not presented with that treatment?

Question two: Will students presented with the concrete objective treatment be better able to select appropriate exercises for practice than students not presented with that treatment?

Question three: Will students presented with the defined and concrete objective treatment be able to get a higher the score on the application posttest than students not presented with that treatment?

Question four: Will students presented with the defined and concrete objective treatment be able to use less time to read the text than students not presented with that treatment?

Need for the Study

This study was undertaken to investigate two relatively unexplored areas: (a) the effects of objectives on application tasks, and (b) the dynamics of subjects' thinking as they use objectives. Previous studies have shown that objectives are useful tools for communicating test requirements for recall tasks. But research has not demonstrated that objectives can serve to help subject's learning application tasks.

Thus, this study will investigate how objectives should be stated to promote learning of an application task from text. This study will show the influence of certain qualities of objectives that thus far have not been systematically combined. The study's principal value therefore lies in what it contributes to present knowledge of the effects of objectives and students' learning processes regarding application tasks. It will have implications for the design of any instruction where subjects must learn to do a task other than recall from a text. Further, this study could provide a more detailed idea about what makes an objective specific and complete.

There have been no studies exploring what students say they are doing with the objectives that they have been given. Thus, this study will examine the dynamics of the use of objectives. The study will look at the mediating variables of attention to text content, and of choice and use of text exercises as they influence a student's learning of an application task from text. Learning how students use objectives to choose content and exercises may verify what researchers have hypothesized as to the role that objectives play in directing attention and guiding study. It may also alert designers as to other factors which affect the use of orienting devices like objectives.

Outline of the Study

Chapter II presents a review of literature as background for the study and leads to the questions that provide a framework for this study.

Chapter III describes the research design, the subjects involved in the study, and the methods employed. The results of the pilot study and the procedures used to collect and analyze the data are also reported. Chapter IV presents the results of the investigation and reports the findings related to the research questions. Chapter V contains a discussion of the findings, conclusions, limitations, implications of the study, and recommendations for future research.

Chapter II

REVIEW OF THE LITERATURE

Two major questions are being asked in this study: (a) What is the effect of communicating application task test requirements on students' cognitive processes during learning of application tasks?, and (b) what is the effect of communicating application task test requirements on students' achievement of those application tasks? Consequently, this study has two purposes: (a) to investigate the effect of communicating course requirements via objectives, and (b) to explore students' cognitive processing of test requirements through given objectives to choose relevant content and practice exercises. Therefore the review of literature is divided into two sections. The first body of literature to be reviewed considers ways to communicate to students application task test requirements via objectives. The second body of literature to be reviewed addresses students' cognitive processing during learning.

The researcher used the Educational Resources Information Center (ERIC) service to review the recent literature on the study of objectives, students' cognitive processing, attention, and learning. In addition, the researcher carefully checked and traced reviews of related literature.

An Overview of Theoretical Relationships among Objectives, Learning Activities, and Student Achievement

The review of literature is structured to support the following theoretical relationships. In the rest of the chapter, evidence is presented to substantiate these relationships and to lead toward the present research questions.

To learn from prose text in formal learning settings, students must choose relevant content. Further, to prepare themselves for tests in instructional settings, students also must often choose relevant exercises for practice. To make relevant choices of content and practice, students must know the test requirements.

One strategy, to provide students with the knowledge of what is required on the test, is the instructional objective. If students clearly understand the concept of what is on the test as explained in the objective, students will be able to selectively attend to the content and the exercises that will help to produce achievement.

Instructors can best communicate using instructional objectives when the objectives are defined and concrete (Yelon, 1991). A defined objective is a statement clearly describing the limits of the domain of the subject matter of the test. For example, an instructor might define a domain in an objective by stating that students will be expected to identify examples of four types of validity. In contrast, an instructor might leave the objective undefined by stating that students are to identify examples of a measurement idea. If an objective is defined, students can attend to relevant content of a text, because the label assigned to the domain or the attributes of the defined domain are clear.

A concrete objective is a statement that denotes the referent test clearly. If an objective is concrete, that means it describes the test conditions and behavior clearly. For example, a concrete objective might be: Given a written case vignette such as "a researcher correlated a perceived social support measure with a general self-esteem measure to show that perceived social support was a part of the self-esteem variable," students will choose which type of validity the example illustrates from these choices: content, concurrent, construct, and predictive validity. Students can then choose appropriate means to prepare for the test, because the test situation and performance are clear. If students can attend and study the relevant content and choose the best practice for a test, they are likely to achieve what the test requires.

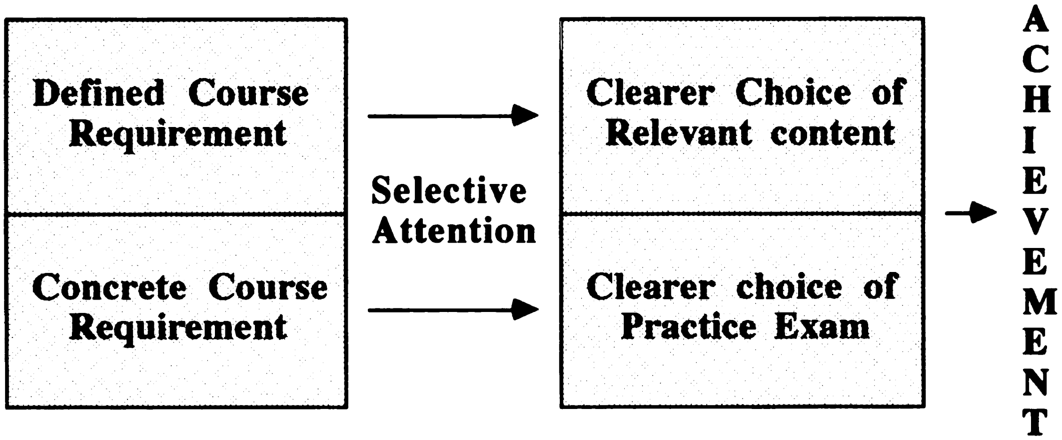

Figure 2-1. Theoretical Relationships among Objectives, Learning Activities and Student Achievement

Figure 3-1 shows a model based on the described relationships among objectives, learning activities, and student achievement . Note how defined requirements aid students in attending selectively to relevant content, how concrete requirements aid students in attending selectively to practice exams, and how relevant content and appropriate practice lead to achievement.

This study investigates the effects of communicating application task requirements on students' learning processes and achievement. An application task is a task in which learners are not merely engaging in rote learning, but attempting to use the idea in new situations. For example, application tasks may include identification of new examples, explanation, or prediction of new cases.

Most research on the instructional effects of objectives has shown that objectives clearly communicate instructional requirements for recall tasks but are not as effective in orienting students for tasks other than recall (Barker and Hapkiewicz, 1979; Duell, 1974; Duchastel, 1980; Ho, Savenye, & Haas, 1986; Kaplan & Rothkopf, 1974; Rothkopf & Kaplan, 1972). Perhaps the qualities present in a recall objective and the qualities present in an application objective must be different to be effective. It may be that the domain of subject matter to be learned to achieve an application task is not as clear to students as the domain in a recall task, and therefore, the domain in an application task objective must be clearly defined to be effective. It may also be that the task of recall is apparent to students. When there is a recall test, students generally know what the test will be like. But the test for an application task is not obvious, it must be specified. Thus, an application task objective must include a concrete example of the test question. The logic continues that students receiving a defined application objective will be able to efficiently direct their attention to the defined content in an assigned reading and students receiving a concrete application objective will be able to select an exercise matching the example given in the objective. When students attend to relevant content and choose exercises that match the test conditions and behavior, they are likely to learn the application task efficiently and effectively.

Thus, there is one main research question: Does the presentation of application task objectives which define a subject domain and concretely exemplify a required test affect students' learning process and resulting achievement? There were two subsidiary research questions: (a) Does the presentation of application task objectives which define a subject domain help students to know what to attend to in their assigned reading?, and (b) does the presentation of application task objectives which concretely exemplify a required test help students to know which exercise to select when given a choice? There is also a practical question posed by this study: Are objectives an effective tool in helping instructors successfully communicate instructional requirements of application tasks?

Research on Objectives

This section of the review of literature on objectives is divided into research on the effects of objectives on learning, and writings about characteristics of effective objectives. The subsections of the review of research on effects of objectives on learning deal with: (a) effects of objectives on recall and application tasks, (b) effects of objectives on relevant and incidental outcomes, and (c) effects of specific and general objectives. The subsections on the characteristics of objectives deals with effects of defined objectives and concrete objectives.

What is an Objective?

Kibler & Bassett (1977) referred to objectives as statements of "what students will be able to do or how they will be expected to behave after completing a prescribed unit of course of instruction (p. 55)." Similarly, Hamilton (1985) defined objectives as "preprose statements that are intended to focus the student on the to be tested material (p. 66)." An objective includes certain elements such as specific conditions of testing, observable test behavior, definition of criteria, and the lower limits of acceptable performance (Yelon, 1991). Davis, Alexander, and Yelon (1974) defined the behavior in an objective as "the component of a learning objective that describes the behavior of a student after instruction (p. 33)." They also defined the conditions as "the component of a learning objective describing the situation in which the student will be required to demonstrate the terminal behavior; the component that describes the test conditions (p. 37)." Although some authors refer to criteria and lower limits of objectives, for the purpose of this research, discussion of objectives is concentrated only on conditions and behaviors.

Effects of Objectives on Guiding Learning

The use of objectives is one way to communicate test requirements to students. In theory, providing students with objectives enables them to orient their learning activity towards the specific desired behaviors that must be mastered to complete the instructional requirements satisfactorily (Kibler & Bassett, 1977).

Most early experiments on the use of objectives asked only if the presence of objectives produced learning and resulted in unreliable and inconclusive findings (Kibler and Bassett, 1977). Sometimes objectives had a positive effect on learning and sometimes they did not. Thus, mere presence of any sort of objective, constructed in any manner, was not sufficient to produce effects on learning. In their early review of literature on the use of objectives, Kibler and Bassett (1977) also said that research had not consistently demonstrated any differential effects on student learning attributable to the way in which objectives were stated. At that time most research dealt with gross differences between general and specific objectives. The researchers at that time did not vary the characteristics of specificity or clarity of objectives except in a very broad manner, that is, whether the objectives were behavioral or not behavioral, whether or not they included traditional parts of objectives. In addition, Kibler and Basset pointed out that in 1977 there were too few studies available on these questions to infer conclusions. However, in a more recent review, Hamilton (1985) resolves some questions about the effects of objectives, but still points out the varying effects of objectives on different tasks. He notes that there are only a couple of studies on the effects of objectives on application tasks.

Hamilton as well as other researchers state that research on objectives has suggested some clear relationships as well as some puzzles yet to be solved. Three important relationships that may serve as guides to further research are: (a) the effect of objectives on recall versus applied tasks, (b) the effect of objectives on relevant versus incidental outcomes, and (c) the effect of general and specific objectives on learning.

Effects of objectives on recall and application tasks

Objectives are effective for the learning of verbal information (Duchastel, 1980; Ho, Savenye, & Haas, 1986; Kaplan & Rothkopf, 1974; Rothkopf & Kaplan, 1972). However, objectives have not been found as effective for learning of application tasks as they have for the learning of verbal information. For example, Barker and Hapkiewicz (1979) found that a group with no objectives achieved the same score as a group with objectives on a posttest calling for an evaluation task. Duell (1974) also found no difference on an application task between an experimental group with objectives and a control group without objectives.

Researchers agree that the effectiveness of objectives to influence learning differs as a function of type of knowledge of the task to be learned (Hamilton, 1985; Kibler & Bassett, 1977; Lewis, 1981; Melton, 1978). After reviewing quite a large number of research studies on objectives, they all concluded that objectives have consistently produced positive effects on achievement for recall tasks while producing no effects or small effects on achievement for application tasks. Hamilton showed that recall objectives with fewer than two of the traditional components suggested by Mager (1962), that is, conditions, behaviors, and criteria, produced one of the highest difference scores of the treatment groups in a set of experiments. Hamilton stated that when an objective points out the information to be learned in a text, the learning effect will be strong. When more information is provided than the information to be learned for a recall task, the learning effect is likely to hindered. Hamilton stated:

> The lack of need for specificity or completeness of the goals/objectives to produce positive effects may be a function of the low level of learning outcome. That is, too much information may interfere with the processing of to be learned information when only a very superficial level of processing is required. The need to present complete and specific objectives (per Mager's definition) may occur only at higher level learning outcomes. The relationship between specificity of goals/objectives and measured learning outcomes should be the focus of future research (p. 78).

Thus, one interpretation of the findings that objectives are effective for the learning of verbal information but not for application tasks is that the most effective objectives for the learning of verbal information are <u>specific</u> and <u>complete</u> for those purposes, whereas the objectives for application tasks are not as specific and complete for those purposes. Students not provided with clear orienting directions for an application task would probably expect to be given a recall test and would not expect a higher level test over the text material (Duell, 1974).

To be specific and complete, the objectives for application tasks must be clearly defined and concrete in nature. When given a recall objective describing a test of recall of verbal information, such as the direction to write the four causes of World War II, it is relatively easy for students to select relevant content from a text and to know what to expect on the test. Therefore, students can prepare for the test by choosing the most relevant content and by using the learning activity that is most compatible with the described end state. For example, if the desired outcome is rote recall of four causes of WW II, the relevant content is clearly defined and perhaps the most appropriate activity is practicing recall of the four causes. Suppose, however, that the desired outcome is an application task, that is, comprehension of the significance of information contained in given material, such as, to analyze a story, or to apply the information to a novel problem, such as, to know the appropriate statistic for a given problem. Then, students might have difficulty in selecting relevant content from a text and knowing what to expect on the test, since the content is not defined nor is the task stated concretely. For application tasks objectives, to be effective in fostering learning, it seems plausible that the domain of content must be defined and a concrete description and example of the task must be included.

Because application tasks require the additional skills of identifying and selecting the relevant pieces of information that are useful in solving new problems (Lyon & Gettinger, 1985), if the content is not defined nor concrete, students may have difficulty distinguishing what content is important and what practice is appropriate. In other words, when the objectives are not defined and not concrete as they are in most commonly written application objectives, the relevant content and practice is not obvious. In support of this view, Glover, Plake, and Zimmer (1982) found that objectives for higher-order learning outcomes were more difficult to describe and classify than were objectives for lower-order outcomes. What exactly is the content domain? Which stories? Which problems? Which statistics? What is the test form? How will stories and problems be given? How will the students respond? What will be relevant information and what will be the appropriate learning activity?

Thus, the research question in this study concerns the degree to which students learn something when confronted with various kinds of objectives about an application test. If an application objective lacks some important characteristics to make it specific and complete, then it cannot be of help to students in orienting themselves to desirable learning activity for the application test. Although students must modify their learning activity in light of their ideas of the nature of the test, it is a difficult task for average students. It is made more difficult when students' ideas about an application test are based on an undefined and an abstract objective. That may be why some objectives are effective for learning verbal information but not for learning application tasks. Therefore, defined and concrete application objectives seem likely to help students to modify their learning activity for the desired outcomes. The ability to modify one's activities in light of changes in the nature of the test is an essential factor in efficient learning for that test.

Effect of objectives on relevant and incidental outcomes

Researchers have been concerned about what difference objectives can make to students on relevant learning. There are a large number of studies that support the effectiveness of objectives on relevant learning (Duchastel & Brown, 1974; Kaplan, 1974; Kaplan & Rothkopf, 1974; Kaplan & Simmons, 1974; Rothkopf & Billington, 1975, 1979; Rothkopf & Kaplan, 1972). However, some researchers (Barker & Hapkiewicz, 1979; Duell, 1974) found that objectives made little difference to students on relevant learning. Melton (1978) discussed the anomaly by concluding: "Clearly, it is not sufficient to simply provide students with behavioral objectives. They must also be aware of them (p.293)." He further concluded that behavioral objectives made little difference to students who were highly conscientious, or well motivated. Such highly motivated students can achieve regardless of whether or not the objectives are specified. Although there are some exceptions in the effectiveness of objectives on relevant learning, researchers generally conclude that objectives are effective for the learning of relevant content (Hamilton, 1985; Lewis, 1981; Melton, 1978).

Researchers are also concerned that objectives may depress incidental learning. Some researchers claim that objectives indicate to students what is required of them, and as a result incidental learning is depressed (Duchastel & Brown, 1974; Frase & Kreitzberg, 1975; Rothkopf & Billington, 1975, 1979). They argue that objectives discourage students from expanding their horizons by encouraging them to confine their learning to specified tasks, and as a result incidental learning is depressed. On the contrary, some researchers found that objectives had little or no effect on depressing incidental learning (Duell, 1974; Kaplan & Rothkopf, 1974; Rothkopf & Kaplan, 1972). In fact, Kaplan and Rothkopf concluded that the provision of objectives enhanced incidental learning as well as relevant learning.

The reason that objectives are effective in helping students to choose and learn relevant content is apparently that clearly defined and limited objectives cue students to attend to specific categories of content. So it is no surprise that well specified, defined objectives affect the learning of relevant content. However, researchers do not explain the reason why the presentation of objectives may sometimes depress learning of incidental content and at other times make little difference in incidental learning. Researchers have had little to say about the reasons for students' learning of incidental content because they have not investigated the students' learning activities or mental processes during preparation for the test. Research thus far simply included a posttest to measure the incidental learning.

One reason for the conflicting results on incidental learning might be that incidental learning is unaffected by objectives when objectives are poorly defined. If students have no clear idea of what is to be learned, they are likely to learn incidental as well as relevant content. When objectives are precisely defined in terms of the domain of content to be learned, then incidental learning is likely to be depressed. Another reason might be that incidental learning may be unaffected by objectives when the objectives are not concrete. If an objective does not specify the conditions and behavior and no examples are given of the task, students may seek more information than specified already to be sure they are prepared for any event.

In sum, if students have difficulty distinguishing what content is important, they will also have difficulty studying. Quite simply, one cannot selectively attend to important material in the absence of precise limits to what is important. Therefore, to the extent that application objectives are defined and concrete, students can direct their attention to relevant content and practice exercises.

Effects of general and specific objectives on learning

Although some studies have found no difference between the effects of general objectives and specific objectives (Duell, 1974), specific goals are generally thought to enhance performance. Frase and Kreitzberg (1975) conducted a study which assessed the effects of general and specific goals on students' achievement. The group given the specific goals performed better than a control group given no objectives and better than a group given general goals, while controlling for any potential encoding specificity effect. Several other researchers (Rothkopf & Kaplan, 1972; Kaplan & Rothkopf, 1974) also noted that the performance of students provided with precisely stated objectives was significantly better than that of students provided with either vaguely stated instructional objectives or short paragraphs of information. Stein (1978) also confirmed this view by noting that when objectives are vague, students do not perform well. Thus, it appears that specific objectives enhance performance.

But, what makes an objective specific? Researchers have found that increasing the number of goals reduced students' performance (Kaplan & Rothkopf, 1972; Rothkopf & Billington, 1975; Rothkopf & Kaplan, 1974). Increasing the number of goals may lead to broad coverage of content to be learned, thereby, reducing students' performance. Thus, perhaps to increase a performance, a specific objective should be defined to help a student focus. Further, if objectives do not include examples of tests, students expect retention types of tests, even though tests are supposed to be higher order questions (Duell, 1974). Therefore, a specific objective may be thought of as concrete as well. Thus, an objective can be considered specific when the content domain is defined and when the task is concretely described and illustrated.

Summary

An objective that is abstract and vague is likely not to be helpful to students' learning. Perhaps that is the reason that application objectives, which are usually abstract and vague, usually have been found not to affect on learning. However, if application objectives are defined and are concrete they should produce greater achievement than the usual abstract or vague application objectives.

Characteristics of Effective Objectives

There are good reasons to believe that if students are given objectives carefully structured for a given task, the objectives will have an effect on learning. As mentioned, objectives are likely to be influential if they are defined and concrete.

Defined objectives

First, objectives must be defined, that is, they must limit the content. When objectives are defined, a student can choose relevant content from the text they study.

A defined objective is a form of an objective in which the domain of subject matter is specified and the range of subject matter on the test is limited. In a defined objective, the labels assigned to the content requirements or the attributes of the content domain are so clear that a reader could choose examples of relevant test content with little doubt and with little error. Brown, Campione, and Day (1981) supported the usefulness of defined objectives by arguing that exact specification of the rules that could be used to achieve a goal was an extremely effective instructional route.

In prose learning, because an entire document is usually not relevant, it must be searched selectively, and an optimal solution maximizes accuracy and minimizes time. Guthrie (1988) suggested the optimal solution as a component that can activate the selection of categories to develop students' ability locating information in documents. He proposed a cognitive processing model to account for performance on locating information in documents. An important and first component of his model is a form of objective that can lead readers to relevant information. According to Guthrie, effective instruction should include that component.

Therefore, if an objective is defined, students can pick out relevant content from their texts. A defined objective includes conditions in which classes or types of the test content are specified, and classes and types of the behavior and its object are specified. Therefore, a defined application objective should limit all content variations in conditions and behavior.

Concrete objectives

Though potentially useful, limited objectives alone cannot facilitate performance better than do more general objectives. Second, therefore, objectives must probably also be concrete, that is, they must give the student a clear idea of the test form. Duell (1974) suggested that when orienting directions are not clear, students would probably expect recall questions even though tests were supposed to be higher-order questions. With a concrete idea of the required task, students can think of the most appropriate means to study for the test.

Concrete objectives denote the referent test clearly. Because a concrete objective matches the referent test, students can pick out a relevant test form and therefore choose the most appropriate exercises or practices. Guthrie (1988) suggested that readers must be able to verbalize an objective in the form of information that is to be found in the document. Therefore, objectives that include the form of information in the document may be essential components in successful reading.

Concrete objectives enable learners to recognize that a given test or practice exercise belongs to a class that shares a common characteristic or property. Once learners have the concrete objectives, they can correctly identify the examples of appropriate practices and tests from nonexamples. When teachers orient students with objectives, they are attempting to teach them a concept of the test. How should the concept of the test be communicated most clearly? Researchers suggest that a learner's ability to correctly apply concepts is significantly influenced by the specific combination of examples and nonexamples used to teach the concept (Tennyson & Park, 1980; Tennyson & Cocchiarella, 1986). Thus, to give students a clear concept of the test, teachers should use concrete examples or concrete descriptions of what the test will be like. If the concept of the test is made clear, then students should be able to pick out examples of a practice test or matching exercise to prepare for the test.

A concrete objective includes concrete conditions in which the example of the test and the description of the variations in test conditions are stated, and concrete behaviors in which observable behaviors and objects of the verbs are denoted. Therefore, in an application objective, concrete conditions have to show the variations in their descriptions and examples, and an operational statement of behavior. In other words, the test situation and the test performance should be clear. Duchastel (1977) even suggested that instructors should give students practice tests items to insure the best use of objectives. It makes sense then to add practice items to objectives to make them clear.

Summary

For an objective to be specific and complete it must apparently define the content to be learned and supply a concrete example of the test. When given an objective that is concrete as well as defined, students can selectively attend to relevant information and choose the most appropriate exercises to prepare for a test.

Adjunct Questions as a Concrete Indicator in an Objective

Using questions is an effective instructional strategy. Questioning can be traced back to Socrates who used a chain of questions to lead students to conclusions. Following the tradition of Socrates, several researchers have tried to develop theories of learning using questions (Anderson & Faust, 1974; Collins, 1978; Sigel & Saunders, 1979). Recently, Collins and Stevens (1983) developed a cognitive theory of inquiry teaching that emphasizes the importance of questioning in learning.

Using questions can also an effective orientation strategy to alert students to what is going to be on a test. Adjunct questions, a concept developed by Rothkopf (1965), are questions presented before, during or after text to help students learn. For example, adjunct questions may alert students as to what is going to be on a test based on the text. It is a subset of research on "mathemagenic" activities. Rothkopf suggested that a teacher might provide additional activities to the traditional prose text that would induce the reader to more actively participate in the reading and learning process.

In the research on adjunct questions, students are given texts to read with questions inserted either before or after paragraphs that contain relevant content. In these studies, prequestions usually facilitate verbatim and factual learning (just like the effects of objectives on recall tasks), while post questions facilitate conceptual learning or learning of information not specific to the question (Boker, 1974).

For example, Watts and Anderson (1971) compared three types of postquestions: the repeated example, application questions, and control. The repeated example was for the retention of a concept or principle, and the application questions were for the transfer of a concept or principle. The group given application adjunct questions achieved better on application posttest questions than did the other two groups .

Felker and Dapra (1975) confirmed Watts and Anderson's results by comparing five types of adjunct questions: (a) post-adjunct comprehension question group, (b) pre-adjunct comprehension question group, (c) pre-verbatim adjunct question group, (d) post-verbatim adjunct question group, and (e) control group. They found that adjunct comprehension post questions produced significantly better performance on the problem-solving test than all other types of questions.

Why are prequestions effective for facts, while postquestions are effective for application tasks? Fact prequestions are easy to interpret and direct students' attention to relevant content while comprehension prequestions may not be as easy to interpret. On the other hand, even though they may be harder to interpret, comprehension postquestions give students an opportunity to reread the relevant content and infer the objective as well as an opportunity for monitoring their comprehension.

Frase (1968) compared the effect of "broader" adjunct questions and "specific" adjunct questions on recall learning. He found that broader questions led to poorer posttest performance. He explained that broad questions may have altered the subjects' conception of the task so that they did not attend to the specific material that was included in the posttest.

Researchers attribute the effect of adjunct questions on learning to an increase in attention caused by questions (Reynolds & Anderson, 1982; Reynolds, Standiford, & Anderson, 1979) and an enhancement of the opportunity for using comprehension monitoring (Brown, Bransford, Ferrara, & Campione, 1984). Thus, the literature on the use of adjunct questions and the use of objectives is tied to the literature on students' cognitive processing during learning.

Summary

Adjunct prequestions usually facilitate factual learning, while adjunct post questions facilitate conceptual learning. In general, specific adjunct questions are more effective than are broad ones. The present study asks: Would an example of a specific adjunct prequestion inserted in an objective as a concrete indicator of the test serve to help students choose relevant content and choose appropriate practice?

Research on Students' Cognitive Processing during Learning

The effects on telling students the course requirements depend largely on what the learners think about during learning. Learners must actively process the orientation messages they are given. Objectives don't automatically produce learning. Objectives give students an idea of the test format, and the relevant content. But students must apply the objectives to infer the best content and the best practice to prepare for the test. Two important factors for the application of objectives are attention students give to significant or relevant information, and strategies they tailor to the learning situation.

Attention

Attention is a student thought process that may help to explain some of the student's learning (Reynold & Anderson, 1982; Reynold & Shirey, 1988; Wittrock, 1986). Students vary in their attentive capacities (Hagen & Hale, 1973; Miller & Weiss, 1981). Some students can be fully attentive for long periods of time, others for short periods only. Some are more distractable than others.

More importantly, some can selectively attend to important material while others have difficulty to attend to what is important. Many educators stress the importance of paying attention during learning, since the ability and willingness to pay attention is a major factor in school learning. It is this process where active mental effort is expended and comprehension takes place. Those students who can pay attention most efficiently to important material may learn the most and achieve the most. Many researchers of learning disabilities see attentional deficit as the most critical defect of the learning disabled child (Hagen & Hale, 1973; Rutter, 1989).

Achievement is generally regarded to be closely related to attention. Higher achieving students are more inclined to attend to learning (Peterson, Swing, Braverman, & Buss, 1982; Peterson, Swing, Stark, & Wass, 1984) and they make more effective use of the cognitive strategy of attention allocation than do lower achieving students (Reynolds and Shirey, 1988).

Good learning strategists are attentive to the demand placed on them (Pressley, Goodchild, Fleet, & Evans, 1989). In order for the strategy of attention allocation to be effective, the student must have the capability to utilize the parameters of the task and the text to determine the importance of text elements.

To understand, learners must seek information about the significance or relevance of facts. Therefore, students must engage in active strategies to ensure increased attention to important material that will not be retained automatically. As human beings mature, they become better able to identify what are the essential organizing features and crucial elements of texts. If students have difficulty distinguishing what is important, they will also have have difficulty studying. Quite simply, one cannot selectively attend to important material in the absence of a fine sensitivity to what is important. Therefore, if students use objectives, they can use them to direct their attention to relevant content and study means.

Objectives may indicate to the learner the information in the text that will be the focus of the test (Hamilton, 1985). Specific objectives are especially helpful in locating information in textbook reading. Guthrie (1988) suggests a theoretical model to account for a student's use of an objective in finding relevant information in text. The model includes five components: (a) goal formation, (b) category selection, (c) extraction of information, (d) integration, and (e) recycling. The model states that a specific goal or an objective as an important component to orient readers to important information.

Researchers have also found that objectives function by influencing selective attention (Anderson, 1982; Shirey & Reynolds, 1988). In research on the effects of giving students objectives, an attentional model has provided a useful explanation of the findings (Wittrock,1986). Anderson (1982) proposed an attentional theory of prose learning as follows:

> (1) Text elements are processes to some minimal level and graded for importance.
>
> (2) Extra attention is devoted to elements in proportion to their importance.
>
> (3) Because of the extra attention, or a process supported by the extra attention, important text elements are learned better than other elements (p. 292).

Summary

Objectives are useful only when students use them as a tool to guide their attention to the important content in text and to the best practice exercises. Thus, attention is an important mediating variable leading to achievement.

Strategies

One of the primary modes through which students acquire information and knowledge in an academic setting is by reading expository prose (Calfee & Drum, 1986; Hamilton, 1985; Just & Carpenter, 1987). Researchers studying reading comprehension have shown that a reader's ability to use orienting devices as objectives while processing a prose passage is positively related to the ease of comprehension and retention of the prose passage (Anderson, 1982; Brown, Campione, & Day, 1981; Guthrie, 1988; Guthrie & Kirsch, 1987; Hamilton, 1985). Orienting devices help students to focus on important content and to use study time efficiently. Thus, students are able to focus adequate amounts of quality attention on the important information in order to learn it.

Learning strategies influence student behaviors and thoughts about the best way to learn (Wittrock, 1986). Therefore, successful strategies are learning processes that, when matched to the requirements of tasks, facilitate performance.

Some strategies can be used only in very specific situations in particular domains (Pressley, Goodchild, Fleet, & Evans, 1989). There are sets of particular strategies tailored to each of these situations (Pressley et al., 1989) and students must tailor their activities precisely to the competing demands of requirements in order to become effective learners (Brown, Campione, & Day, 1981).

There is a long history of interest in the types of strategies students bring to the task of learning from texts. Some learning strategies are rehearsing information, elaborating information, and organizing information. For example, students may use notetaking, underlining, adjunct aids, question asking, and outlining to rehearse, elaborate, and organize. Comprehension monitoring is one of the most important strategies for learning information and finding relevant content in text. It is also of use in test preparation. Another learning strategy is engaging in the preparation and practice for a test. All of the strategies mentioned are related to students' selection of text content and selecting exercises or practice in preparation for a test.

Strategies related to choosing relevant content of text

Students must tailor their learning strategies to the demand placed on tasks. If the desired outcome is rote recall, perhaps the most appropriate strategy is mnemonic elaboration. If, however, the desired outcome is comprehension of the significance of information contained in the material or the application of the information to a novel problem, then the appropriate activity would change. Guthrie and Kirsch, (1987) found that locating information in text and reading comprehension are two separate factors in text reading. Therefore, an appropriate learning activity must be one that is compatible with the desired end state.

The knowledge of textual importance, knowledge of suitable strategies, and estimation of one's current state of mastery have been found in a series of school-like tasks such as notetaking, outlining, summary writing, and retrieval-cue selection. Within the series of studies conducted by Brown and her colleagues, qualitative differences were repeatedly found in the types of notes, summaries, and outlines produced by spontaneous users of a comprehension monitoring strategy (Brown, 1980; Brown &

Day, 1983; Brown & Smiley, 1978). Comprehension monitoring may be the most important strategy that affects the use of objectives.

Comprehension monitoring is closely related to students' use of objectives (Reynolds & Shirey, 1988). Comprehension monitoring requires the student to establish learning goals for an instructional unit or activity, to assess the degree to which these goals are being met, and, if necessary, to modify the strategies being used to meet the goals. Comparisons of good and poor comprehenders have consistently shown that poor comprehenders are deficient in the use of active learning strategies needed to monitor understanding (Weinstein & Mayer, 1986). Palincsar and Brown (1984) demonstrated that students' learning was improved by orienting them to a particular direction and monitoring it. Therefore, if students are given an objective that is clearly defined and concrete, students can use it to choose relevant content of a text and can monitor the degree to which the requirements are being met.

Strategies related to choosing exercises

Practice simulating the actual nature of a criterion task may be the most important student learning activity. Several researchers (Anderson, 1980; Hannafin, 1987; Mayer, 1984) emphasized the importance of practice during instruction. Duchastel (1977) suggested that to insure that objectives will be used most efficiently, students should be given valid practice with objectives and the class of material to be learned. Hannafin (1987) found that the combination of practice and orienting activity produced a significant interaction as well as a powerful effect of practice.

He contended that orienting activity alone was not a significant instructional component. Nitch (1977) also showed that the kind of practice students engage in has an important effect on type of test, that is, recall or application. In Nitch's study, students who had received practice that required them to act in varying contexts performed better on an application test than students who had received practice that required them to act in the same context. Varied-context practice was better preparation for the application task requiring use of a concept, whereas same context practice produced faster rote learning of the particular exemplar in the original task.

When objectives are not concrete, in the absence of other cues, students cannot be sure of the specific requirements of the test and they cannot choose or make the most out of practice opportunities. How can students be expected to perform well when confronted with a test that they are not prepared to handle adequately because they chose the wrong practice? Thus, when students are told concretely what a test will be like, students can adjust their learning strategy in light of their knowledge concerning the actual nature of the test, that is, they can choose the best practice for the test. The ability to adjust one's practice activities in light of information about the nature of the test is an essential factor in efficient learning.

Students make decisions in study to practice in certain ways. If students are given a clear notion of the test requirements, then they should be able to pick a practice exam that matches the test. In fact, to be successful, students must find matching practice because practice interacts with the orienting activity (Hannafin, 1987; Hamilton,1985). To do well in an exam for a particular objective, a student must engage in a related practice. In other words, objectives alone are not a significant instructional component. It is what students do with objectives to guide their choices of practice that is significant. Therefore, if students are given an objective that is clearly defined and concrete, students can use it to choose appropriate practice.

Summary

Defined and concrete objectives by themselves will not be effective. They are tools to help guide students' attention. Students must employ learning strategies to use the information in the objectives to select the most important content in text and to choose the best practice exercises for the test. Attention acts as a mediating variable leading from the defined and concrete objective to appropriate learning strategies and from there to achievement.

Research Questions

The theoretical question of this study is what combination of characteristics of an objective most effectively and efficiently influence the application of ideas learned from text? This study is based on a hypothesis which states: the more concretely stated the task in the objectives and the more carefully defined the subject matter stated in the objective (other things being equal), the more effective the influence on the application of ideas learned from text. The reasoning for this result is that when given a specific defined domain, students can selectively attend to the relevant information in the text; when given a concrete idea of a task, students can think of the most appropriate means to study the text. Furthermore, when given the most relevant content and the most appropriate practice, subjects are likely to achieve the most.

As a consequence, specific research questions are:

Question 1: Will students presented with the defined objective treatment be able to select the more relevant content than students not presented with that treatment?

Question 2: Will students presented with the concrete objective treatment be better able to select appropriate exercises for practice than students not presented with that treatment ?

Question 3: Will students presented with the defined and concrete objective treatment be able to get a higher the score on the application posttest than students not presented with that treatment?

Question 4: Will students presented with the defined and concrete objective treatment be able to use less time to read the text than students not presented with that treatment?

Chapter III
METHOD

The purpose of this chapter is to describe the research design and the methods of investigation employed in the study. The pilot study, sample, instrumentation, and data analysis are also reported.

Research Design

An experimental research design was used to answer four research questions. The research design is a posttest only control-group experiment (Campbell and Stanley, 1963). The posttest only control-group design was used because a pretest could act as an orienting device, and may confound the treatment effects.

Fifty-six volunteer students in education participated in this study. Subjects were randomly assigned to one of four treatments: defined and concrete objective, defined and not concrete objective, concrete and not defined objective, and not defined and not concrete objective.

Subjects participated individually or in groups of between two to five, each receiving his or her own treatment. The researcher administered the experiment. Before the experiment, all subjects answered questions about their previous experience with objectives and with correlation, the subject matter to be studied. Next, subjects read along as they listened to a tape describing instructions for the experiment. Then they read their own objective of an application task dealing with the statistical subject: correlation.

The experimenter asked the subjects to learn to perform the application task: "choosing the appropriate correlational technique for a given set of data." To choose an appropriate technique for a given set of data, a student must recall the type of data associated with the correlational technique. But the task involved more than recall. Subjects had to remember the attributes of each correlational technique required and apply those attributes to new examples to be able to identify the right technique. Thus, the task was an example of concept identification, and as such, was a short mental skill with as least five steps: (a) study the data, (b) recall characteristics of types of data, (c) identify the types of data, (d) recall the technique associated with the type of data, and (e) choose the appropriate name of the technique.

One group was given the most complete objective including a clearly limited domain of content required for the posttest, a precise description of the task behavior and the task conditions, as well as a concrete example of a test item. Following is an example of the <u>most defined and concrete</u> course requirements in the form of an objective:

Given data regarding <u>only</u> combinations of continuous and artificial dichotomy variables, such as:

Student	SAT Scores	Algebra Test (Success=1; Failure=0)
Doyle	350	0
Sabers	450	1
Glass	550	1

etc.

you are to circle the name of the appropriate correlation technique from only these choices:

a. Pearson Product-moment correlation

b. Tetrachoric correlation

c. Biserial correlation

The second group was given an objective including a clearly limited domain of content required for the posttest. However, the objective's behavior was somewhat vague and no example of the type of item was included. Following is an example of the defined but not concrete objective:

For only combinations of continuous and artificial dichotomy variables, you are to know the appropriate correlation technique from only the following choices:

a. Pearson Product-moment correlation

b. Tetrachoric correlation

c. Biserial correlation

The third group was given an objective with a concrete example of the type of test item to appear on the posttest. The test behavior was precisely stated, but the general description of the test conditions was relatively vague. Also the subject matter domain was not limited to certain types of correlations. Following is an example of the concrete but not defined course requirements:

Given some data, such as:

Student SAT score Socioeconomic Status (High=1; Low=0)

Moll	350	1
Chipman	450	0
Hopkins	550	1

etc.

you are to circle the name of the appropriate statistical technique from a list of techniques given such as:

a. Pearson Product-moment correlation

b. Tetrachoric correlation

c. Biserial correlation

The fourth group was given an objective including a general and abstract description of the task and the content. The domain was not limited and an example of the test item was not included. Following is an example of the course requirements that are neither defined nor concrete:

Know the appropriate statistical techniques.

All four groups read the same text about correlation containing relevant and incidental content as it pertained to the posttest. All subjects were asked to highlight the relevant content as they saw it. In addition, to determine how they were using the objectives, all subjects were asked to answer a question about why they chose the content they did. Students were allowed to use written objectives given to them and to write on the text and make notes on the printed text.

The experimenter measured the time for reading the material for all subjects. The time was measured by subtracting the time of starting reading the material from the time of asking for exercises.

After reading the text, subjects were asked to return the written objectives and text material they used, and to choose one among four types of sample exercises which could help them to prepare for the posttest. After choosing an exercise type from the samples, students were asked to perform a set of exercises like the one they chose. Again, to determine how they were using the objectives, all subjects were asked to answer a question about why they selected the exercise they did.

Then all students took a test applying the content read by choosing the appropriate correlational technique for a given set of data. The total time for the procedure was estimated to be 30 minutes.

Sample

Fifty-six volunteer graduate students from Michigan State University were recruited from classes in the College of Education and from personal contact. Among the 56 subjects 12 were male and 44 were female. Out of 56 subjects, 46 subjects were from the College of Education. The other subjects' majors were advertising (2), family and child ecology (1), management (1), zoology (1), psychology (1), linguistics (1), computer science (1), and geography (1). One subject didn't indicate a major. Nineteen subjects were in doctoral programs and 37 subjects were in master's programs. Regarding native language, 40 subjects used English as their native language while 16 subjects used English as a second language. They were randomly assigned to one of the four groups: (a) defined content and concrete task, (b) defined content, (c) concrete task, and (d) neither defined content nor concrete task.

The University Committee on Research Involving Human Subjects (UCHRIS) at Michigan State University reviewed a form for protecting human subjects and approved the study (Appendix A, B, and C). The researcher maintained confidentiality throughout the study. Only the researcher and the researcher's adviser could access the data. During the whole process of the study, no complaints or procedural problems were encountered.

Pilot Study

A pilot study was carried out before the main experiment. The primary purpose of the pilot study was to test the instruments for this study with a sample of eight graduate students enrolled in Michigan State University.

During the pilot study subjects were strongly encouraged to give feedback and suggestions as they progressed through the experiment. The researcher used the information collected to refine the instrument for this study. Two major problems were encountered in the pilot study. First, the researcher found that the readability of the text material caused confusion for some subjects. As a result, the researcher worked with a faculty member on the researcher's dissertation committee to refine the text material. The researcher also found that some subjects ignored written instructions about the experiment. As a consequence, the researcher included tape-recorded instructions in the main experiment. The researcher identified and corrected any problems which were encountered with the procedure of experiment.

The pilot study was also to determine whether the research questions were worth asking. Even based on the limited results for eight subjects, the results seemed promising.

Instrumentation

The instruments used in this study were prequestions, objectives, a text, exercises, and a posttest.

Posttest

A posttest of ten questions applying the ideas of correlation was created along with a description of the task in defined/broad - concrete/abstract terms (see Appendix K). The posttest was assessed by the researcher and the researcher's adviser for structure and content validity against the text. The posttest was scored by giving one point for each correct answer. The posttest included ten questions such as:

1. Here is some data:

Student	GRE scores	Socioeconomic Status (High=1; Low=0)
Anderson	350	1
McLeod	450	0

Short	550	1

etc.

circle the name of the appropriate correlation technique from these choices:

a. Pearson product-moment correlation

b. Biserial correlation

c. Tetrachoric correlation

Questions Regarding Prior Knowledge

Before the experiment began, subjects were asked about their previous experience with the subject matter domain of correlation and with the use of objectives (see Appendix D). Four questions were asked about self-rated prior knowledge of correlation, and four questions were asked about self-rated prior knowledge of objectives.

The four questions about prior knowledge of correlation were about the subjects' experience in taking a course including correlation, understanding the meaning of correlation, being able to calculate correlation, and applying correlation ideas. Subjects responded to the last three questions on a five-point Likert scale ranging from very well to adequately to very poorly. Subjects' responses were scored with 5 points for very well, 4 points for well, 3 points for adequately, two points for poorly, and one point for very poorly. Subjects' responses to the last three questions were added to form a score for prior knowledge of correlation.

The four questions about prior knowledge of objectives were about the subjects' experience in taking a course about objectives, understanding the meaning of objectives, being able to write objectives, and applying ideas about objectives. Subjects' responses were scaled and scored as were the correlation knowledge questions.

The prequestions were assessed by the researcher and the researcher's adviser.

Objectives

The validity of the objectives and their degree of narrowness and concreteness were ranked by the researcher and the researcher's adviser. The complete forms of objectives can be found in Appendix E.

Text

Text was paraphrased from two major statistics textbooks (Borg & Gall, 1983; Glass & Hopkins, 1984) and sentences were assessed as to relevant and irrelevant with regard to the most explicit objective by the researcher's adviser and a faculty member on the researcher's dissertation committee (see Appendix F). The readability of the text was also checked by the researcher's adviser and the faculty.

The text consisted of eleven paragraphs: six relevant paragraphs and five irrelevant paragraphs. Each paragraph was labeled from A through K. A blank preceded each paragraph for students to check. Subjects were asked to check the blank if they thought the paragraph contained relevant content.

The content of the text was assessed by the researcher and the researcher's adviser for relevant and irrelevant against the defined and concrete objective.

Exercises

Exercises were based on the four objectives. Therefore, four categories of exercises were made: a defined and concrete exercise, a defined and not concrete exercise, a concrete and not defined exercise, and an exercise that was neither defined and nor concrete (see Appendix J). Each exercise was accompanied by a separate page with answers to give subjects feedback. The exercises were assessed by the researcher and the researcher's adviser for structure and content validity for adherence to the four objectives.

The defined and concrete exercise was matched with course requirements; hence, it included consistent conditions, behaviors, and content to course requirements. The exercise included three questions like this:

Here is some data that include continuous and artificial dichotomy variables:

Student	GRE Scores	SES (High=1; Low=0)
Hart	350	1
Levin	510	0
Cuerton	470	1

etc.

circle the name of the appropriate correlation technique from these choices:

a. Pearson product-moment correlation

b. Tetrachoric correlation

c. Biserial correlation

The defined and not concrete exercise was only matched to the content of course requirements. The exercise included three questions like this:

A Pearson product-moment correlation is to be used when relating two continuous variables.

True _____ False _____

The concrete and not defined exercise was only matched to the conditions and behaviors of course requirements. The exercise included three questions like this:

Here is some data:

Student	GRE scores	Marital status (Married=1; Not married=0)
Clark	556	1
Blase	550	0
Walker	460	1

etc.

circle the name of the appropriate statistical technique from these choices:

a. Kendall's tau

b. Rank-difference correlation, rho

c. Phi correlation

The neither defined and nor concrete exercise was matched with none of the course requirements. The exercise included three questions like this:

Kendall's Tau is more likely to be misinterpreted than rho.

True _____ False _____

Method to Assess the Choice of Relevant Content

After highlighting the relevant content, all students were asked to answer a questionnaire (Appendix G) that included the following question: Why did you choose and highlight the content you did as the most relevant?

The highlighting was scored for number of relevant paragraphs chosen and the number of irrelevant paragraphs chosen by giving one point for each relevant paragraph and one point for each irrelevant paragraph. The points were assigned based on the judgement of the researcher and another rater. The open-ended answers to the question were summarized by categorizing the reasons for the choices by the researcher and the researcher's adviser.

Method to Assess the Choice of Exercise

After choosing the exercises, all students were asked to answer a questionnaire (Appendix I) that includes following question: Why did you select the exercise you did? The reason for the choice of exercise were summarized by categorizing them for the choices by the researcher and the researcher's adviser.

The choice of exercise was scored as "best exercise" or "not the best exercise". The choice of the most defined and concrete exercise was regarded as the "best exercise", and the choice of defined but not concrete exercise, concrete but not defined exercise, and neither defined and nor concrete exercise were regarded as "not the best exercise".

Reliability

The posttest was evaluated for internal reliability using the Cronbach Alpha formula. The estimate of Cronbach Alpha is the degree to which the item responses correlate with the total score.(Mehrens & Lehmann, 1984). The internal reliability was .53. Possible reasons for this moderate reliability are discussed in chapter V.

Data Analysis

The data analysis has two main parts: a statistical analysis and a qualitative analysis. The statistical analysis has three parts. First, data from the experiment were analyzed to describe the characteristics of the sample. Second, data from the experiment were analyzed to answer the four main research questions. Third, data from the experiment were analyzed to answer important questions not addressed in the research questions. For qualitative analysis, the data collected from each subject about his/her reasons for selecting text content and exercises was analyzed to help explain the quantitative results and to help shed light on the mental processing subjects use when thinking about objectives. Section one of the qualitative analysis concerns subjects' selection of content and section two concerns subjects' selection of exercises. The researcher coded and analyzed the data.

Statistical Analysis

Preliminary analysis

The preliminary analysis was concerned with three variables: prior knowledge of objectives, prior knowledge of correlation, and posttest score. For prior knowledge of objectives and correlation, preliminary analysis was concerned with any preexisting differences among treatments. For posttest score, the preliminary analysis was concerned with the influence of outliers. The preliminary analysis included descriptive data, ANOVA test results, and correlation data for these three variables.

Main analysis of the research questions

The main analysis includes inferential analyses regarding the four research questions.

Question one stated: "Will students presented with the defined objective treatment be able to select the more relevant content than students not presented with that treatment?" To answer the question, data were analyzed using a 2 x 2 Analysis of Variance (ANOVA), where the number of relevant sentences chosen by subjects was the dependent variable and the defined objective treatment (yes versus no) and concrete objective treatment (yes versus no) were the two independent variables.

Question two stated: "Will students presented with the concrete objective treatment be better able to select appropriate exercises for practice than students not presented with that treatment?" To answer the question, data were analyzed using the chi-square test, for group differences in the choice of exercise.

Question three stated: "Will students presented with defined and concrete objective treatment be able to get a higher the score on the application posttest than students not presented with that treatment?" To answer the question, data were analyzed using a two-way of ANOVA to compare the posttest performance among treatments, where the subjects' posttest score was the dependent variable and the defined objective treatment and concrete objective treatment were the two independent variables. Also question three was analyzed using nonparametric Puri and Sen ANOVA test (Harwell, 1988). Effect sizes and regression coefficients were also calculated to assess the size of treatment effects.

Question four stated: "Will students presented with the defined and concrete objective treatment be able to use less time to read the text than students not presented with that treatment?" To answer the question, data were analyzed using a two-way of ANOVA, where the subjects' time for reading text was the dependent variable and the defined objective treatment and concrete objective treatment were the two independent variables, to analyze the time used to read the text.

Subsidiary analysis of relationships

To relate the results from the ANOVA, the nonparametric, regression, and correlational analyses the researcher performed a path analysis. The path analysis aims to verify the theoretical model discussed in Chapter III.

Chapter IV
FINDINGS

This study investigates the effects of communicating application task requirements on students' learning processes and achievement. This chapter presents the data from the experiment and reports the findings which are related to the four research questions posed in Chapter I and elaborated on in Chapter III. The data collected on the sample of the 56 subjects involved in the experiment were statistically analyzed to test the four questions.

Data Analysis

The data analysis has two main parts: a statistical analysis and a qualitative analysis.

Statistical Analysis

The statistical analysis has three parts. First, data from the experiment were analyzed for the overall characteristics of the sample. This procedure was to support the main analysis. Second, data from the experiment were analyzed to answer four main research questions. Third, data from the experiment were analyzed to answer important questions not addressed in the research questions.

Preliminary analysis

The preliminary analysis was concerned with three variables: prior knowledge of objectives, prior knowledge of correlation, and posttest score. For prior knowledge of objectives and correlation, preliminary analysis was concerned with any preexisting differences among treatment groups. For posttest score, the preliminary analysis was concerned with the influence of outliers. The preliminary analysis included descriptive data, ANOVA test results, and correlation data for these three variables.

Prior knowledge of objectives. Self-rated prior knowledge of objectives ranged between 3 and 15 points out of 15 possible maximum points. Out of 56 subjects, 41 subjects had taken a course that taught objectives and 15 subjects had not taken any such course. Subjects who had taken the course about objectives had a mean score of 12.07 with a standard deviation of 2.44 and subjects who had never taken any course about objectives had a mean score of 7.20 with a standard deviation of 3.67. Table 1 summarized the means and standard deviations of prior knowledge for subjects who had an objective course and who had not.

Table 1. Means and Standard Deviations of Prior Knowledge of Objectives

	Mean	SD	N
Subject who had taken a course about objectives	12.07	2.44	41
Subjects who had never taken a course about objectives	7.20	3.67	15
Total	10.77	3.54	56

The researcher performed a one-way ANOVA test to compare the group differences with regard to the prior knowledge of objectives. The test result showed that there was difference in self-rated knowledge about objectives between subjects who had taken a course on objectives and subjects who had never taken a course on objectives, $F(1,55) = 32.97$, $p=.000$. The results implied that subjects who had taken a course on objectives regarded their knowledge higher than subjects who had never taken a course on objectives. Table 2 showed the ANOVA results for the group differences with regard to the prior knowledge of objectives.

Table 2. One-Way ANOVA Results for Prior Knowledge of Objectives

Variable	df	ss	ms	F	p
Taking a course about objectives	1	260.80	260.80	32.97	.000
Residual	54	427.18	7.91		
Total	55	687.98			

The researcher performed further preliminary analysis concerning any preexisting differences among treatments regarding prior knowledge of objectives. Subjects who were in the defined and concrete objectives treatment had a mean of 11.93 with a standard deviation of 2.37. Subjects who were in the defined only treatment had a mean of 10.50 with a standard deviation of 4.45. Subjects who were in the concrete only treatment had a mean of 9.21 with a standard deviation of 3.37. Subjects who were in the neither defined nor concrete treatment had a mean of 11.43 with a standard deviation of 2.98. Table 3 displayed the means and standard deviations of subjects in treatment groups for prior knowledge of objectives.

Table 3. Means and Standard Deviations of Prior Knowledge of Objectives as a Function of Treatment Condition

	Defined		Nondefined		Y_C	
	Mean	SD	Mean	SD	Mean	SD
Concrete	11.93	2.37	9.21	3.37	10.57	3.37
Nonconcrete	10.50	4.45	11.43	2.98	10.96	3.75
Y_D	11.21	3.57	10.32	3.51	*10.77	*3.54

(Y_D= means and SD for the defined objective treatment; Y_C= means and SD for the concrete objective treatment; * = Grand mean and SD)

The researcher performed a two-way ANOVA test to assess any preexisting differences on students' prior knowledge of objectives before treatments. As shown in Table 4, there were no differences on students' prior knowledge of objectives with regard to both the defined treatments, $F(1,55)=.92$, $p=.34$, and the concrete treatments, $F(1,55)=.18$, $p=.67$. Also, there was no interaction effects at the .05 level of significance, $F=3.85$, $p=.055$.

Table 4. Two-Way ANOVA Results for Prior Knowledge of objectives

Variable	df	ss	ms	F	p
Defined	1	11.16	11.16	.92	.34
Concrete	1	2.16	2.16	.18	.67
D * C	1	46.45	46.45	3.85	.055
Residual	52	628.21	12.08		
Total	55	687.98			

However, the researcher was concerned about the interaction effect between the defined objective treatment and the concrete objective treatment. Because the effect was very close to .05 level of significance, it could not be ignored. It suggested that one of the cell means may be different from the others. As a result, the researcher analyzed the subjects' prior knowledge of objectives with a one-way ANOVA. As shown in Table 5, there was no difference in self-rated prior knowledge of objectives among the four groups. In other words, the four treatment groups were homogeneous regarding the self-rated prior knowledge of objectives.

Table 5. One-Way ANOVA Results for Prior Knowledge of Objectives

Variable	df	ss	ms	F	p
Treatment	3	59.77	19.92	1.65	.19
Residual	52	628.21	12.08		
Total	55	687.98			

Prior knowledge of correlation. Subjects' scores on self ratings on their prior knowledge of correlation ranged between 3 and 15 points out of 15 possible maximum points. Out of 56 subjects, 35 subjects had taken a course that taught about correlation and 21 subjects had not. As shown in Table 6, subjects who had taken a course including correlation had a mean score of 9.77 with a standard deviation of 2.50 and subjects who had never taken any course including correlation had a mean score of 5.95 with a standard deviation of 2.87. Table 6 summarized the results.

Table 6. Means and Standard Deviations of Prior Knowledge of Correlation

	Mean	SD	N
Subjects who did take a course including correlation	9.77	2.50	35
Subjects who did not take a course including correlation	5.95	2.87	21
Total	8.34	3.22	56

The researcher performed a one-way ANOVA test to assess group differences with regard to prior knowledge of correlation. The test result showed that there was a difference in self-rated correlation knowledge between subjects who had taken a course including correlation and subjects who had never taken a course including correlation, $F(1,55)= 27.41$, $p=.000$. Table 7 showed the ANOVA results.

Table 7. One-Way ANOVA Results for Prior Knowledge of Correlation

Variable	df	ss	ms	F	p
Taking a course about correlation	1	191.43	191.43	27.41	.000
Residual	54	377.12	6.98		
Total	55	568.55			

The researcher performed further preliminary analysis concerning any preexisting differences among treatments regarding prior knowledge of correlation. Subjects who were in the defined and concrete objectives treatment had mean of 8.36 with a standard deviation of 3.50; those in the defined only treatment had mean of 8.14 with a standard deviation of 2.88; those in the concrete only treatment had mean of 8.36 with a standard deviation of 2.87; and those in neither the defined nor the concrete treatment had mean of 8.50 with a standard deviation of 3.86. Table 8 summarized the results.

Table 8. Means and Standard Deviations of Prior Knowledge of Correlation

	Defined		Nondefined		Y_C	
	Mean	SD	Mean	SD	Mean	SD
Concrete	8.36	3.50	8.36	2.87	8.36	3.14
Nonconcrete	8.14	2.88	8.50	3.86	8.32	3.35
Y_D	8.25	3.15	8.43	3.34	*8.34	*3.22

(Y_D= means and SD for the defined objective treatment; Y_C= means and SD for the concrete objective treatment; * = Grand mean and SD)

The researcher also used a two-way ANOVA test to analyze any preexisting differences of students' prior knowledge of correlation. The results showed that there were no differences of students' prior knowledge of correlation between treatments. Table 9 shows the results.

Table 9. Two-Way ANOVA Results for Prior Knowledge of Correlation

Variable	df	ss	ms	F	p
Defined	1	.45	.45	.04	.84
Concrete	1	.02	.02	.00	.97
D * C	1	.45	.45	.04	.84
Residual	52	567.64	10.91		
Total	55	568.55			

Descriptive information about the posttest. As shown in Table 10, posttest scores ranged between 2 and 10 points. The average score was 7.91 out of 10 possible points with standard deviation of 2.57. As shown in Table 11, out of 56 subjects, 27 had 10 points (48.2%), six had 9 points (10.7%), two had 8 points (3.6%), four had 7 points (7.1%), four had 6 points (7.1%), four had 5 points (7.1%), six had 4 points (10.7%), one had 3 points (1.8%), and two had 2 points (3.6%). The distribution of subjects' posttest scores were negatively skewed.

Table 10. Descriptive Data for the Posttest

Mean	7.91	S.E Mean	.34	Std. Dev	2.57
Variance	6.59	Kurtosis	- .70	S.E. Kurt	.63
Skewness	- .85	S.E. Skew	.32	Range	8.00
Minimum	2.00	Maximum	10.00	Sum	443.00

As shown in Table 11, there were two outliers among four treatments, one in <u>the defined and concrete</u> objective treatment and one in the <u>defined only</u> objective treatment. An outlier is a research subject whose scores differ markedly from the general pattern established by other subjects in the sample. Note the lowest scores in each of those two categories.

Table 11. Frequency of Posttest Scores by Treatment

Score	Defined & Concrete	Defined only	Concrete only	Neither	N
10	10	8	6	3	27
9		2	2	2	6
8		1	1		2
7	1	1		2	4
6	1		2	1	4
5	1	1	1	1	4
4		1*	2	3	6
3				1	1
2	1*			1	2

* Outliers

<u>The relationship of the posttest to prior knowledge of objectives and correlation</u>. The researcher considered the possibility of prior knowledge of objectives and correlation as covariates. The correlation between the posttest scores and prior objective knowledge scores was -.37 with a significance level of .01. That correlation meant that subjects who had highly rated their prior knowledge of objectives had low posttest scores. Because of this negative correlation, the researcher further analyzed the data by computing correlation between the self-rated prior knowledge of objectives score and the posttest score for each treatment group. The correlation between the posttest scores and prior objective knowledge scores was -.46 for the defined and concrete treatment group, -.33 for the defined only treatment group, -.72 for the concrete only treatment group, and -.18 for the neither defined nor concrete treatment group.

The correlation between posttest and prior correlation knowledge was .14 and was not significant even at .05 level. The correlation between posttest and prior correlation knowledge was also analyzed by computing a correlation between the self-rated prior knowledge of correlation score and the posttest score for each group. The correlation between the posttest scores and prior correlation knowledge scores was .11 for the defined and concrete treatment group, -.35 for the defined only treatment group, .12 for the concrete only treatment group, and .51 for the neither defined nor concrete treatment group.

Because of the negative relationship between posttest score and prior knowledge of objectives, and low relationship between posttest score and prior knowledge of correlation, two variables were not appropriate covariates for the analysis of the posttest results.

Table 12. Correlational Matrix for all the Study's Variables

	Pcor	Defin	Concr	RT	RC	RI	CS	EX	Post
Pobj	-.01	.13	-.05	-.33*	-.05	-.12	.03	-.14	-.37**
Pcor		-.03	.01	.32*	.20	.26	.11	.06	.14
Defin			.00	.07	.45**	-.22	-.22	.35**	.29*
Concr				.15	.14	-.07	.00	.35**	.13
RT					.41**	.35**	.18	.20	.29*
RC						.21	-.06	.50**	.51**
RI							.48**	-.09	-.22
CS								-.38**	-.40**
EX									.51**

(Pobj=Self-rated Prior Knowledge of Objective, Pcor=Self-rated Prior Knowledge of Correlation, Defin=Defined Objective, Concr=Concrete Objective, RT=Reading Time, RC=Selection of Relevant Content, RI=Selection of Irrelevant Content, CS=Choice of Sample Exercise, EX=Exercise Performance, Post=Posttest Score)
** < .01; * < .05

Main analysis of the research questions

The main analysis includes inferential analyses regarding the four research questions. Let us consider each question in turn.

Research question one. To answer question one, "Will students presented with the defined objective treatment be able to select more relevant content than students not presented with that treatment?", the researcher used a two-way ANOVA to determine the differences in selecting relevant content between treatments.

As shown in Table 13, the group with the defined objective treatment had a mean score of 4.89 out of 6 possible points while the group with the nondefined objective treatment had a mean score of 3.43.

Table 13. Mean Scores of Relevant Content by Type of Objective

	Defined		Nondefined		Y_C	
	Mean	SD	Mean	SD	Mean	SD
Concrete	4.71	1.49	4.07	1.54	4.39	1.52
Nonconcrete	5.07	1.14	2.79	1.53	3.92	1.76
Y_D	4.89	1.31	3.43	1.64	*4.16	*1.65

(Y_D= means and SD for the defined objective treatment; Y_C= means and SD for the concrete objective treatment; * = Grand mean and SD)

The ANOVA test was to determine the effect of the definition on students' selection of text content. As noted in Table 14, the highly significant ANOVA result showed that there was a treatment effect of the defined objective treatment on students' selection of relevant text content. This implies that subjects were more likely to choose relevant content while reading the text if they were given a defined rather than a nondefined objective treatment. However, the effect of definition appeared only in the nonconcrete objective condition. As shown in table 13, the effect of definition was prominent in the nonconcrete objective condition (5.07 vs. 2.79), but not in the concrete objective condition (4.71 vs. 4.07). The post hoc test, Studentized Newman-Keuls (SNK) method, showed that the difference between 5.07 and 2.79 was significant at .05 level, but was not significant between 4.71 and 4.07.

The ANOVA test also assessed the treatment effect of concreteness on the choice of relevant content. Similarly, though the ANOVA results indicated that concreteness did not influence subjects' choices of relevant content, there was an effect of concreteness. But the effect appeared only in the nondefined objective condition. As shown in table 13, the effect of concreteness was prominent in the nondefined objective condition (4.07 vs. 2.79), but not in the defined objective condition (4.71 vs. 5.07). The SNK test confirmed the significant difference between 4.07 and 2.79 at .05 level.

Table 14. Two-Way ANOVA Results for the Selection of Relevant Content

Variable	df	ss	ms	F	p
Defined	1	30.02	30.02	14.58	.00
Concrete	1	3.02	3.02	1.47	.23
D * C	1	9.45	9.45	4.59	.04
Residual	52	107.07	2.06		
Total	55	149.55			

The researcher also checked if the defined objective treatment influenced the choice of irrelevant content. As shown in table 15, the group with the defined objective treatment had a mean choice of 1.43 with standard deviation of 1.87 out of 5 possible choices while the group with the nondefined objective treatment had a mean choice of 2.25 with standard deviation of 1.82 out of 5 possible choices. For the concreteness effects, the group with the concrete objective treatment had a mean choice of 1.96 with standard deviation of 1.82 out of 5 possible choices while the group with the nonconcrete objective treatment had a mean choice of 1.71 with standard deviation of 1.96 out of 5 possible choices.

Table 15. Mean Scores for Selecting Irrelevant Content by Types of Objective

	Defined		Nondefined		Y_C	
	Mean	SD	Mean	SD	Mean	SD
Concrete	1.36	1.60	2.57	1.87	1.96	1.82
Nonconcrete	1.50	2.18	1.93	1.77	1.71	1.96
Y_D	1.43	1.87	2.25	1.82	*1.84	*1.88

(Y_D= means and SD for the defined objective treatment; Y_C= means and SD for the concrete objective treatment; * = Grand mean and SD)

As shown in Table 16, a two-way ANOVA test was used to test the group difference on subjects' choice of irrelevant content. The results indicated that the presence or absence of the defined or the concrete objective treatment had no effect on students' choice of irrelevant content. There was no interaction effect on students' choice of irrelevant content, either.

Table 16. Two-Way ANOVA Results for the Selection of Irrelevant Content

Variable	df	ss	ms	F	p
Defined	1	9.45	9.45	2.71	.11
Concrete	1	.88	0.88	.25	.62
D * C	1	2.16	2.16	.62	.43
Residual	52	181.01	3.48		
Total	55	193.55			

Research question two. To answer question two, "Will students presented with the concrete objective treatment be better able to select appropriate exercises for practice than students not presented with that treatment?", the researcher used a chi-square test to determine the differences between experimental conditions in choosing an exercise type.

As noted in Table 17, the test results showed that there was no difference in the frequency of choosing the best exercise between those students with or without the concrete objective treatment. The test results also showed that there was no difference in the frequency of choosing the best exercise between those students with or without the defined objective treatment.

Table 17. Frequency and Chi-square Test Results of Selection of Exercise by Type of Objective

	Right	Wrong
Concrete	16	12
Nonconcrete	16	12
	χ^2 (1) = .00, p= 1.00	
	Right	Wrong
Defined	19	9
Nondefined	13	15
	χ^2 (1) = 2.63, p = .11	

Research question three. To answer question three, "Will students presented with the defined and concrete objective treatment be able to get a higher the score on the application posttest than students not presented with that treatment?", the researcher used a two-way of ANOVA test to determine the effect of the defined and the concrete course requirement on students' posttest achievement.

As shown in Table 18, the subjects receiving the defined objective treatment (Y_d) had a mean posttest score of 8.64 points with a standard deviation of 2.26 while the subjects receiving the nondefined objective treatment had a mean posttest score of 7.18 points with a standard deviation of 2.68 (N=56). The subjects receiving the concrete objective treatment

(Y_C) had a mean posttest score of 8.25 points with a standard deviation of 2.46, while the subjects receiving the nonconcrete objective treatment had a mean posttest score of 7.57 points with standard deviation of 2.67 (N=56).

Table 18. Means of Posttest Scores by Treatment with and without Outliers

	Defined			Nondefined			Y_C		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Concrete									
with all subject	56	8.57	2.56	56	7.93	2.40	56	8.25	2.46
w/o one outlier	55	9.08	1.80	55	7.93	2.40	55	8.48	2.17
w/o two outliers	54	9.08	1.80	54	7.93	2.40	54	8.48	2.17
Nonconcrete									
with all subject	56	8.71	2.02	56	6.43	2.82	56	7.57	2.67
w/o one outlier	55	8.71	2.02	55	6.43	2.82	55	7.57	2.67
w/o two outliers	54	9.00	1.78	54	6.43	2.82	54	7.67	2.67
Y_D									
with all subject	56	8.64	2.26	56	7.18	2.68	56	*7.91	*2.57
w/o one outlier	55	8.89	1.89	55	7.18	2.68	55	*8.02	*2.46
w/o two outliers	54	9.04	1.75	54	7.18	2.68	54	*8.07	*2.45

(Y_D= means and SD for the defined objective treatment; Y_C= means and SD for the concrete objective treatment; * = Grand mean and SD)

As noted earlier, there were two outlying scores on the posttest. Without one outlier, the mean posttest score and standard deviation of each treatment showed as follows: 8.89 with 1.89 for the defined objective treatment group and 7.18 with 2.68 for the nondefined objective treatment group; 8.48 with 2.17 for the concrete objective treatment group and 7.57 with 2.67 for the nonconcrete objective treatment group. Without two outliers, the mean posttest score and standard deviation of each treatment showed as follows: 9.04 with 1.75 for the defined objective treatment group and 7.18 with 2.68 for the nondefined objective treatment group;

8.48 with 2.17 for the concrete objective treatment group and 7.67 with 2.67 for the nonconcrete objective treatment group.

The researcher performed a two-way ANOVA test including all subjects (N=56), then the researcher performed the ANOVA without one outlier (N=55), and then without both outliers (N=54) to assess the effect of treatments without those outliers.

Table 19. Two-Way ANOVA Results for the Posttest Score

Variable	df	ss	ms	F	p
Defined					
56	1	30.02	30.02	4.93	.03
55	1	40.45	40.45	7.65	.008
54	1	46.64	46.64	9.13	.004
Concrete					
56	1	6.45	6.45	1.06	.31
55	1	11.91	11.91	2.25	.14
54	1	8.38	8.38	1.64	.21
D * C					
56	1	9.45	9.45	1.55	.22
55	1	4.44	4.44	.84	.36
54	1	6.84	6.84	1.34	.25
Residual					
56	52	316.64	6.09		
55	51	270.14	5.30		
54	50	255.28	5.11		
Total					
56	55	362.56			
55	54	326.99			
54	53	317.13			

As described previously, a defined course objective is a statement that limits the domain of subject matter clearly. As listed in Table 19, the defined course objectives influenced the subjects' achievement on the posttest. Subjects given the defined objective treatment were substantially more likely to attain higher scores than subjects given the nondefined objective treatment, $F(1,54) = 4.93$, $p = .03$. Without the outliers, the defined objective treatment showed an even more significant result. Without one outlier, the defined objective treatment produced a positive effect that was significant at less than .01 level, $F(1,53) = 7.65$, $p = .008$. Without two outliers, the effect was increased to a significance of less than .005 level, $F(1,52) = 9.13$, $p = .004$.

Because of the ceiling effect on the posttest, the normality assumption for parametric tests was violated. Note that the distributions of the posttest scores in three of the four treatment groups were negatively skewed (see Table 11). Thus, the researcher double checked the parametric results by using a nonparametric test, the Puri and Sen test, based on the rank score of the subjects' posttest performances.

As shown in Table 20, the subjects receiving the defined objective (Y_d) had a mean rank posttest score of 33.39 while the subjects receiving the nondefined objective had a mean rank posttest score of 23.37. The subjects receiving the concrete objective (Y_c) had a mean rank posttest score of 30.96 while the subjects receiving the nonconcrete objective had a mean rank posttest score of 26.00.

The Puri and Sen test (Harwell, 1988) has the general form, $PS = (N-1)\,\theta \sim \chi^2_{pq}\,(1-\alpha)$, where PS is the Puri and Sen test statistic and θ is a measure of explained variation, that is, a ratio of the explained variation in the ranks to the total variation. The results of the Puri and Sen test were compared to a chi-square value at a chosen level of significance based on pq degrees of freedom, where p was the number of dependent variables and q was the number of independent variables. The Puri and Sen test of rank factorial ANOVA confirmed the parametric results by showing that the defined course objectives influenced the subjects' posttest scores, PS=5.70 (df=1), $p< .05$. Table 21 showed the analysis of nonparametric test results.

Table 20. Mean Ranks of Posttest Scores by Type of Objective

	Defined		Nonconcrete		Y_C	
	N	Mean	N	Mean	N	Mean
Concrete						
with all subject	56	34.14	56	27.79	56	30.96
w/o one outlier	55	35.65	55	26.79	55	31.06
w/o two outliers	54	34.65	54	25.84	54	30.09
Nonconcrete						
with all subject	56	32.64	56	19.43	56	26.00
w/o one outlier	55	31.64	55	18.46	55	25.05
w/o two outliers	54	32.31	54	17.71	54	24.74
Y_D						
with all subject	56	33.39	56	23.37	56	*28.48
w/o one outlier	55	33.57	55	22.63	55	*28.00
w/o two outliers	54	33.48	54	21.79	54	*27.42

(Y_D= means for the defined objective treatment; Y_C= means for the concrete objective treatment; * = Grand mean)

The researcher also used the nonparametric ANOVA to analyze the data without the outliers. The results showed a similar strong effect of the defined course objectives on subjects' posttest scores. Without one outlier, the definition effect was significant at less than .01 level, PS= 7.46 (df=1), $p< .01$. Without two outliers, the definition effect was significant at less than .005 level, PS=8.41 (df=1), $p< .005$.

Table 21. Nonparametric ANOVA Results for Posttest Ranks

	df	56	55	54
Defined	1	5.70*	7.46**	8.41***
Concrete	1	1.45	2.35	1.76
D * C	1	.70	.28	.52

(*** = < .005 ; ** = < .01; * = < .05)

In addition to tests of significance, the researcher calculated the magnitude of the effect of the defined objective treatment in standard units. The effect size estimate, or d-index (Borg & Gall, 1983) is defined as the difference between the means of two experimental conditions divided by the standard deviation of the variable. The standard deviation used in this analysis was pooled standard deviation derived from all subjects. The statement that d=1.00 indicates that an observed mean difference between treatment conditions was equivalent to one standard deviation. Therefore, effect sizes of .2 and .5 would respectively indicate a small and a moderate effect size (Borg & Gall, 1983). The effect size of the defined objective treatment was .5 when all the subjects were included in the analysis. Without one outlier, the effect size was .6. Without two outliers, the effect size was .7.

The researcher also employed a regression analysis to assess the effect that the defined objective treatment had on students' posttest scores. The effect of the defined objective treatment, the concrete objective treatment, and the interaction of the treatments were used to explain the posttest score.

These are regression models derived from those variables:

$$Y = 6.84 + 1.46D + .68C - .41INTER \quad (N=56)$$
$$Y = 6.71 + 1.72D + .93C - .28INTER \quad (N=55)$$
$$Y = 6.78 + 1.86D + .79C - .36INTER \quad (N=54)$$

(D=1 if a subject was in the defined treatment group, D=0 if a subject was in the nondefined treatment group; C=1 if a subject was in the concrete treatment group; C=0 if a subject was in the nonconcrete treatment group; INTER=1 if a subject was in the defined and concrete treatment group or in the neither defined nor concrete treatment group, INTER=-1 if a subject was in the defined only treatment group or in the concrete only treatment group)

where D was the effect of the defined objective treatment, C was the effect of the concrete objective treatment, and INTER was the interaction effect of the treatments. The numbers in parentheses indicate the number of subjects used in each analysis.

The defined objective treatment had a regression coefficient of 1.46 with 56 subjects, 1.72 with 55 subjects, and 1.86 with 54 subjects. The regression coefficients indicate the amount of change in the dependent variable produced by one unit of change in the independent variable. For instance, as a student moves from a nondefined objective treatment setting to a defined objective treatment setting, we would expect an increase in posttest scores of 1.46 points. Likewise, as a student moves from a nonconcrete objective treatment setting to a concrete objective treatment setting, we would expect an increase in posttest scores of .68 points.. This result means that, other things being equal, the presence or absence of a defined objective treatment could produce a 1.46 point difference for the posttest score in the case of 56 subjects, a 1.72 point difference for posttest score in the case of 55 subjects, and a 1.86 point difference for posttest score in the case of 54 subjects. The regression coefficients also indicate that the effect of the concrete objective treatment was about half as the effect of the defined objective treatment.

The researcher also checked the 95% confidence interval of the regression coefficients. The lower and upper boundaries of regression coefficient for the defined objective treatment are .14 and 2.79, -.64 and 2.00 for the concrete objective treatment, and -1.07 and .25 for the interaction effect with 56 subjects. The lower and upper boundary of regression coefficient mean the smallest and highest value for the true effect of the defined objective treatment respectively. Table 22 shows the 95% confidence interval of the regression coefficients with 56, 55, and 54 subjects. Note that without outliers the lower boundaries of regression coefficient for the defined objective treatment is getting higher.

Table 22. 95% Confidence Interval of b

	56	55	54
b_d	0.14 - 2.79	0.47 - 2.96	0.62 - 3.10
b_c	- 0.64 - 2.00	- 0.32 - 2.10	0.45 - 2.02
b_{inter}	- 0.07 - 0.25	- 0.91 - 0.34	- 0.97 - 0.26

Research question four. To answer question four, "Will students presented with the defined and concrete objective treatment be able to use less time to read the text than students not presented with that treatment?", the researcher used a two-way ANOVA test to determine the differences in reading time between experimental conditions.

Table 23. Means of Reading Times by Type of Objective

	Defined		Nondefined		Y_C	
	Mean	SD	Mean	SD	Mean	SD
Concrete	9.36	2.47	11.57	6.17	10.46	4.75
Nonconcrete	10.71	4.68	8.93	5.73	9.82	5.21
Y_D	10.04	3.74	10.25	6.00	*10.14	*4.95

(Y_D= means and SD for the defined objective treatment; Y_C= means and SD for the concrete objective treatment; * = Grand mean and SD)

As shown in Table 23, the subjects receiving the defined objective treatment (Y_d) had a mean reading time of 10.04 minutes with a standard deviation of 3.74 while the subjects receiving the nondefined objective treatment had a mean reading time of 10.25 minutes with a standard deviation of 6.00. The subjects receiving the concrete objective treatment (Y_c) had a mean reading time of 10.46 minutes with a standard deviation of 4.75, while the subjects receiving the nonconcrete objective treatment had a mean reading time of 9.82 with standard deviation of 5.21.

Table 24. Two-Way ANOVA Results for Reading Time

Variable	df	ss	ms	F	p
Defined	1	.64	.64	.03	.87
Concrete	1	5.79	5.79	.23	.63
D * C	1	56.00	56.00	2.26	.14
Residual	52	1286.43	24.74		
Total	55	1348.86			

As displayed in Table 24, ANOVA results showed that there were no treatment effects on subjects' reading time for the text material. The researcher found neither a defined objective treatment effect, F = .03 (p=.87), nor a concrete objective treatment effect, F = .23 (p=.63). There was no interaction effect either, F = 2.26 (p=.14).

Subsidiary analysis of relationships

To relate the results from the parametric, the nonparametric, regression, and correlational analyses, the researcher performed a path analysis. Consider the correlations among all the variables of concern in the study as noted in Figure 1.

The path diagram in Figure 1 reveals a number of interesting significant direct effects on posttest performance. The defined objective treatment, choosing relevant content, and the exercise performance, all showed a positive significant relationship with the posttest score in the correlational analysis (see Table 12).

From the preceding analyses it is apparent that subjects who were given the defined objective treatment were more likely to get higher posttest scores than subjects who were not given the defined objective treatment. However, the path diagram showed that the defined objective treatment affected the posttest performance indirectly. As shown in the path diagram, the path coefficient between the defined objective treatment and the choice of relevant content was .45. This coefficient was the same as correlation coefficient between the defined objective treatment and the choice of relevant content. Then, the path coefficient between the choice of relevant content and the exercise performance was .50. This coefficient was also the same as the correlation coefficient between the choice of relevant content and the exercise performance. However, the path coefficient between the exercise performance and the posttest was .34, and the path coefficient between the choice of relevant content and the posttest was .33. These path coefficients were less than the correlation coefficients of those two relationships.

The reductions from correlation coefficients to the path coefficients were due to interrelationships among all variables. In the path analysis, each successive step counted only the variance which was not counted in the previous step. Therefore, the decreased coefficient from .51 to .33 between the choice of relevant content and the posttest performance meant that the defined objective treatment already explained some portion of the posttest total variance. Likewise, the decreased coefficient from .51 to .34 between the exercise performance and the posttest meant that the defined objective treatment and the choice of relevant content already explained some portion of the posttest total variance.

The path diagram also showed that the path coefficient between the defined objective treatment and the posttest performance was .02. Note that the correlation coefficient between the defined objective treatment and the posttest performance was .29. Therefore, the path diagram clearly showed that the defined objective treatment affects the posttest performance through the selection of relevant content and exercise performance. All this means that the defined objective treatment affects the posttest, but does so indirectly which supports the theoretical model in chapter III.

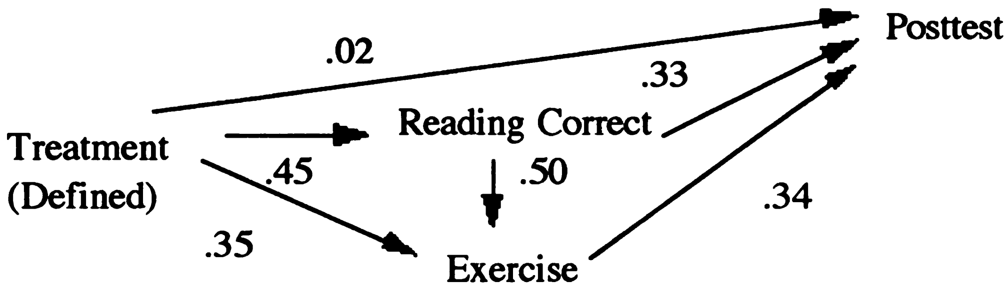

Figure 4-1. A Path Analysis of the Effects of Defined Objective on Students' Posttest Achievement

Qualitative Analysis

The researcher collected data from each subject about their reasons for selecting text content and exercises. Subjects' reasons for their decisions may help explain the quantitative results and may shed light on the mental processing subjects use when thinking about objectives. The first section of the qualitative analysis concerns subjects' selection of content and the second section concerns subjects' selection of exercises.

Analysis of reasons given for selection of text content

After reading the text and choosing relevant content, subjects were asked to write their answer to the question, "Why did you choose and highlight the content you did as the most relevant?" In analyzing subjects' written reasons for selection of text content, the researcher was looking for ways that subjects used of the kind of objective that they were given in each treatment. However, the researcher was equally interested in reasons other than objectives for their selections.

The researcher and researcher's adviser checked subjects' written remarks to see whether they commented or related their choice of relevant text content to objectives. The subjects' written comments were classified according to whether they used words or phrases that denoted objectives. In an interrater agreement, both raters stated that 10 out of 14 subjects in the defined and concrete objective treatment group gave reasons that related to objectives for their choice of relevant content. In other treatment groups with objectives, both raters reported results that were comparable to the most complete treatment: 8 out of 14 in the defined only objective treatment group, and 10 out of 14 in the concrete only objective treatment group. Note that according to both raters only 5 out of 14 subjects in the group with the neither defined nor concrete objective treatment group related their choice of relevant content to objectives. Overall, the interrater agreement of the classifications of reasons given for all treatments was 86.8%. Table 25 shows the interrater agreement among treatments.

Table 25. Interrater Agreement on Subjects' Use of Objectives in Selecting Relevant Content by Treatment

	Rater1	Rater2	Agree	Agreement
Defined and concrete	10	10	10	100%
Defined only	10	8	8	80%
Concrete only	10	10	10	100%
Neither	8	5	5	62.5%
Total	38	33	33	86.8%

Subjects in all treatments used similar words or phrases in mentioning objectives as the reason for selecting relevant content. Some subjects used words with direct reference such as "objective", "instructional objective", "instructions", and "introduction". Some subjects used phrases that denoted the contents of the objectives such as "3 [statistical] tests we would be tested on." Some subjects took phrases right out of the objectives such as "would be used when", taken from "On the test you are to know when to use correlational techniques." Some subjects referred to the purpose of the objective with phrases such as "[needed the content for the] question given later." Table 26 summarizes the the words and phrases given by subjects for choosing the contents and includes the frequency for each response category. The importance of words and phrases used by subjects can be best understood by referring to Appendix L which states the objectives given in each treatment.

Table 26. Frequency of Words and Phrases Used by Subjects to Select Content

	Defined & Concrete	Defined only	Concrete only	Neither
Objective*	7	8	8	4
Instructions	2	0	2	0
Those (three) to be tested	1	2	0	1
When to use	0	0	0	3
N	10/14	10/14	10/14	8/14

(*Includes "instructional objective")

Most subjects in this study were certain as to why they chose content as relevant. When subjects referred to objectives as their reason for selection, they used similar terminology. However, subjects showed marked differences in the way they used objectives in making their choices of content. In other words, some subjects commented on the use of objectives in selecting relevant content, but they failed to use them appropriately, that is, in limiting content. Nine out of ten subjects in the defined and concrete objective treatment group who used objectives in selecting relevant content commented on how the objective helped them see the limits of the relevant content. In comparison, six out of eight subjects in the defined only objective treatment group and four out of ten subjects in the concrete only objective treatment group who used objectives in selecting relevant content made similar comments. Note that no subjects in the neither defined nor concrete objective treatment group who used objectives in selecting relevant content commented on how the objectives helped limit the content. Table 27 summarizes the number of subjects who commented on using objectives to see the limits of the text content. While subjects in the neither defined nor concrete objective treatment group may have known how to use objectives to limit content, they did not because the objective was so general it gave little information as to the limits of the content.

Table 27. Number of Subjects Using Objectives to Limit Content by Treatment

	N	Commenting on objective	Limit content
Defined and Concrete	14	10	9
Defined only	14	8	6
Concrete only	14	10	4
Neither	14	5	0

Those subjects who did not use objectives in their selection of content provided other reasons. Subjects often made comments that related to their prior knowledge of correlation. Some said they selected content as relevant because the content they chose were frequently used correlation techniques. Some stated that their selections were based on what they already knew were important correlation techniques. Thus, some subjects seemed to rely on their prior experience to select relevant content rather than use the objectives they were given for that purpose. Table 28 summarizes reasons given by subjects who did not report using objectives in their selection of content .

Table 28. Abbreviated Reasons Given by Subjects not Using Objectives to Select Content

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<u>Defined and Concrete</u>

- Key word in the test.
- Main definition and examples.
- Subject of correlation between two variables.
- Comparing two variables.

<u>Defined only</u>

- Frequency of usage.
- Pearson is important, and the other could be looked in most statistical books anytime.
- Chose content because ed. researchers should learn all those kinds.
- Highlighted areas that I felt were uniquely significant to understanding each coefficient.

<u>Concrete only</u>

- Most widely used correlation techniques.
- Concept and application.
- Most commonly used formula.
- Terminology.

<u>Neither</u>

- It related to correlation technique used in various data.
- They are related to the content about correlation.
- Because they are important correlations.
- Core concept to understand the correlation.
- The content gave basic information about correlation.

Analysis of reasons given for selecting an exercise

After stating their reasons for choosing relevant content and choosing an exercise to practice for the test, subjects were asked to write their answer to the question, "Why did you select the exercise you did?" In analyzing the subjects' written reasons for their selection of an exercise, in a fashion similar to the preceding analysis on content, the researcher was looking for ways that subjects used of the kind of objective that they were given in each treatment. Again, the researcher was equally interested in reasons other than objectives for the subjects' selections.

As before, two raters checked the subjects' written remarks to see if they related their selection of an exercise to objectives. The subjects' written comments were classified according to whether they used words or phrases that denoted objectives. In an interrater agreement, both raters stated that four out of fourteen subjects in the defined and concrete objective treatment group gave reasons that related to objectives for their choice of exercise. In other treatment groups with objectives both raters reported results that were comparable to the most complete treatment: four out of fourteen in the defined only objective treatment group, three out of fourteen in the concrete only objective treatment group, and three out of fourteen in the neither defined nor concrete objective treatment group. Overall, the interrater agreement of the classifications of reasons given for all treatments was 74%. Table 29 shows the ratings and interrater agreement for each treatment.

Table 29. Interrater Agreement on Subjects' Use of Objectives in Selecting an Exercise by Treatment

Treatment	Rater1	Rater2	Agree	Agreement
Defined and concrete	5	4	4	80%
Defined only	6	5	4	57%
Concrete only	4	4	3	60%
Neither	3	3	3	100%
Total	17	17	14	70%

The numbers of subjects referring to objectives as the reason for selecting an exercise was relatively low and quite similar in all groups. In stating their reasons for selecting an exercise, subjects who referred to objectives used words such as "[instructional] objectives", "criteria [for selection]", "[general instructions]", "[example of] posttest", and "[three choices in the] first paper."

Table 30. Frequency of Words and Phrases Used by Subjects to Select Exercises

	D+C	D	C	Neither
Objective	2	3	2	3
(General) instruction	0	0	2	0
Example of posttest	1	0	0	0
Criteria	0	1	0	0
Three choices in the first paper	1	0	0	0
Correct answer was present	0	1	0	0
It tested what I am supposed to be tested	1	0	0	0
The 3 tests that should be found is included on the final test	0	1	0	0
Example of both Pearson correlation and artificial dichotomous	0	1	0	0
N	5	7	4	3

Subjects also used phrases that denoted objectives such as "Correct answer was present", "It tested what I am supposed to be tested", "The 3 tests that should be found are included on the final test", and "Example of both Pearson correlation and artificial dichotomous." Table 30 summarizes the words and phrases given by subjects for choosing the exercise and includes the frequency for each response category.

Many subjects used criteria other than objectives in their selection of an exercise. Subjects often made comments that related to reading material. Some said they selected the exercise as relevant because the exercise they chose included examples shown in the text they read. Some stated that their selections were based on familiarity of examples. Thus, some subjects seemed to rely on their memory of examples shown in the text to select a relevant exercise, rather than use the objectives they were given for that purpose. Table 31 summarizes reasons given by subjects who did not report using objectives in their selection of exercise.

Note that fewer subjects gave reasons that related to objectives in selecting an exercise than in selecting relevant text content. Perhaps students were making use of the text as well as objectives to make their decisions on the choice of an exercise for practice. Those subjects using objectives to make their selection of an exercise did so two ways. Some subjects were trying to match the exercises to the examples they saw in the objective and text. Other subjects were trying to match the content they recalled from the objective with the content they noticed in the exercise sample. Many subjects referred to the examples given in the objective and the text when stating reasons for selecting an exercise.

Table 31. Abbreviated Reasons Given by Subjects not Using Objectives to Select Exercises

---

<u>Defined and Concrete</u>

Looked a little more interesting.
The question will help me recall definition of the concept.
Like seeing the example.
Most familiar to the way I had set up my study pattern.
I knew the answer.
It doesn't require to remember too many details from the text.
Most familiar with rank (Spearman) order vs. nonrank (Pearson).
The answers fit the material I had studied, in the form I studied it.
It showed the ranking of each country.

<u>Defined only</u>

The data looked familiar to what I had been reading.
The more information I had available the better I could/would do.
While reading the text, I analyzed the data to be able to distinguish between the techniques.
Because I can apply my understanding.
The one I select is described in the content.
Expected some tests that may deal with (mental) recall without engaging calculations.

<u>Concrete only</u>

The term was familiar to me.
I remember the most information about the exercise I selected.
It is appropriate to apply the understanding of variables.
Selected exercise seemed to provide a little bit more information.
Chose the one I can study more.
Easiest to identify scores/rank.
The format allows me to determine based on the information which technique would be applicable given the type of data.
It was the reflecting best the text read.
The true-false format would give me enough information to recall the little bit of knowledge I had gathered.
The most comfortably with continuous score (at least one). The three selections were (a,b,c) most familiar.

<u>Neither</u>

Basically, it was just a matter of choosing one at random. I'd do about the same on any of the tests.
I thought I understand the material.
Familiar with this kind of data analysis.
Remember a little something on ranks.
The one I feel I understand relatively.

Table 31 (cont'd).

It makes you practice when to use a specific kind of correlation technique.
I like the type.
I can't select the correct answer better than when data/information is given rather than selecting T or F without an example.
It related to correlational techniques.
It had familiar looking data arranged in a format that is used regularly in my work related reading.
I remember same thing about rank.

Summary and Integration of the Results

This study investigated the effects of communicating application task requirements using objectives on students' learning processes and achievement when learning from text.

Before the experiment, the researcher was concerned that the subjects' prior knowledge of objectives and the subjects' prior knowledge of correlation would affect the posttest performance and might confound the treatment effects on the posttest score. Corresponding to the researcher's concern, the results showed that subjects who had taken a course about objectives rated their knowledge higher than subjects who had never taken a course about objectives. The results also indicated that subjects who had taken a course including correlation rated their knowledge of correlation higher than subjects who had never taken a course including correlation. However, the correlation between self-rated knowledge of objectives and correlation and the posttest score was negative ($r=-.37$) and low (.14) respectively. These results could be interpreted as meaning that the subjects who felt that they knew more about objectives scored lower on the posttest than subjects who felt that they knew less about objectives, and that subjects who felt they knew more about correlation scored on the posttest about the same as subjects who felt they knew less about correlation. The results also indicated that treatment groups were homogeneous with regard to self-rated prior knowledge of objectives and correlation. Therefore, self-rated prior knowledge of objectives and correlation were eliminated from consideration as covariates. Preliminary analysis also showed two outliers with respect to posttest performance.

The test results of research question one, about the effect of the definition on selecting relevant content, showed that there was a definition effect. But the definition effect appeared only in the nonconcrete objective condition. Similarly, there was a concreteness effect, but the concreteness effect appeared only in the nondefined objective condition.

The test results of research question two, about the effect of concreteness on selecting the appropriate exercise, showed that there was no concreteness effect, no definition effect, and no interaction effect. The results indicated that there was no difference in the frequency of choosing the best exercise between the subjects with or without the concrete objective treatment.

The test results of research question three, about the effect of the definition and the concreteness on posttest performance, showed that there was a definition effect, but not a concreteness effect nor an interaction effect. The results indicated that the defined objective treatment influenced the subjects' achievement on the posttest. Subjects given objectives which defined the subject domain were substantially more likely to attain higher scores than subjects given objectives which did not define the subject domain as precisely. Nonparametric analysis results also confirmed the parametric results of the defined objective treatment effect. The definition effect was stronger without outliers. The effects size of defined objective treatment was .5 when all the subjects were included in the analysis. Without one outlier, the effects size was .6. Without two outliers, the effects size was .7. The regression coefficients of the defined objective treatment added more detailed features of the effect. The defined objective treatment had a regression coefficient of 1.46 with 56 subjects, 1.72 with 55 subjects, and 1.86 with 54 subjects. The regression coefficients indicated the amount of change in the dependent variable produced by one unit of change in the independent variable. For instance, a change of one unit in the defined variable would produce 1.46, 1.72, and 1.86 points higher than in posttest score with 56, 55, and 54 subjects respectively. Therefore, other things being equal, subjects who received objectives which defined the subject domain got 1.46, 1.72, and 1.86 points more than subjects given objectives which did not define the subject domain as precisely with 56, 55, 54 subjects respectively.

The test results of the research question four, about the effect of the defined and the concrete objective treatment on reading time, showed that there was no definition effect, no concreteness effect, and no interaction effect. The results indicated that those subjects' who received objectives which defined the subject domain were not as efficient as those subjects who were given objectives which did not define the subject domain as precisely. The results also indicated that those subjects' who received objectives with a concrete example were not as efficient as those subjects who were given objectives which did not have a concrete example, either.

The path analysis showed that there is an indirect link in the path from the defined objective treatment to the posttest through choosing relevant content and performing well on the exercise. This demonstrated the effect of the defined objective treatment on the process of learning and on students' achievement.

Subjects in each condition showed similarity regarding frequency in using objectives for selecting relevant content. However, their use of objectives in limiting content showed marked differences. Subjects' with the more defined objective treatment were more likely to be able to use the objectives as a guide to limit text content. No subjects in the neither defined nor concrete objective treatment group used objectives as a guide to limit text content. Subjects used concrete examples to limit content when they had no defined content.

Subjects in all treatment groups made relatively less use of objectives in selecting an exercise to prepare for the posttest as compared to their use of objectives as a guide for selecting relevant content. Overall, subjects in all treatment groups used objectives to select an exercise approximately equally. For the selection of an exercise, subjects depended on the examples in the text as well as the example in the objectives.

Chapter V
DISCUSSION AND CONCLUSIONS

The purpose of this chapter is to present a discussion of the findings reported in chapter IV and to relate them to the research questions. This chapter also contains the limitations and implications of the study, and recommendations for future research.

Discussion of the Findings

In reading each section of the discussion, keep in mind that the main research question of this study was: Does the presentation of application task objectives, which define a subject domain and concretely exemplify a required test, affect students' learning processes and resulting achievement when learning from text? The two subsidiary research questions were: (a) Does the presentation of application task objectives which define a subject domain help students to know what to attend to in their assigned reading?, and (b) does the presentation of application task objectives which concretely exemplify a required test help students to know which exercise to select when given a choice?

Prior Knowledge of Objectives

Before the experiment, to assess influence on the results, the researcher asked subjects to rate their knowledge of objectives. Note that self-rating was used instead of a pretest to avoid teaching subjects about objectives. The results showed that the correlation between self-rated knowledge of objectives and the posttest score was negative (r=-.37). This result meant that the subjects who felt that they knew more about objectives scored lower on the posttest than subjects who stated they did not know as much.

One reason for this relationship may be due to the ceiling effect on the posttest. The plot between prior knowledge of objectives and the posttest showed that the relationship would have been zero if there was no ceiling effect. But suppose the effect is not just a measurement artifact. Perhaps this effect came about because subjects who knew how to use objectives were frustrated and confused when less than perfect objectives were given to them. Consequently they did poorly on the posttest. In support of this explanation the researcher noticed that some subjects made remarks about their frustration when stating reasons their use of objectives. Some subjects commented the lack of guidance in objectives such as "I was totally confused".

Note that this result contradicts studies that showed that subjects trained in the use of objectives make more effective use of objectives (Duchastel, 1977). Although this result is inconsistent with past research, it raises the question about what happens when students encounter instructional support that does not conform to what they expect. Teachers may encounter this condition when moving students from a dependent instructional mode to a more independent mode such as from a master's level class to a doctoral one.

Prior Knowledge of Correlation

Just as with the knowledge of objectives, to assess influence on the results, the researcher asked subjects to rate their knowledge of correlation. Here also a pretest may have alerted students to the particular content to be learned and may have inadvertently taught them. The results showed that the correlation between self-rated correlation knowledge and the posttest score was low ($r=.14$). This result could be interpreted as meaning that subjects who felt they knew more about correlation scored on the posttest the same as subjects who felt they knew less. This could mean that the instructional intervention accounted for the effect on the posttest. This result also shows that although prior knowledge is a factor in learning and achievement, it must combine with other factors, such as instructional support or instructional materials to produce achievement.

Selection of Relevant Content

Does the presentation of application task objectives which define a subject domain help students to know what to attend to in their assigned reading? The results showed that those subjects who received objectives which defined the subject domain were more likely to choose relevant content than those subjects who were given objectives which did not define the subject domain as precisely. However, note that subjects who received objectives with a concrete example were not as likely to choose relevant content as those subjects who were given objectives which did not have a concrete example. This supports the theoretical notion that the defined objective treatment would have a stronger effect on choosing relevant content.

However, the effect of definition appeared only in the nonconcrete objective condition. Recall that the mean score on relevant content for the nonconcrete objective treatment with definition was 5.07 compared to 2.79 for the nonconcrete objective treatment without definition. In contrast, the mean scores in the concrete objective conditions with and without definition were not much different: 4.71 and 4.07. The post hoc test, Studentized Newman-Keuls (SNK) method, showed that the difference between 5.07 and 2.79 was significant at the .05 level, but the difference between 4.71 and 4.07 was not. Similarly, though the ANOVA results indicated that concreteness did not influence subjects' choices of relevant content, there was a simple main effect of concreteness in the nondefined objective condition (4.07 vs. 2.79) confirmed by the SNK test at .05 level.

These results may be interpreted to mean that objectives which limit the subject matter domain are useful cognitive tools to help students direct their attention and make decisions when students have no clear idea about the specific appearance of the test. Perhaps the limitations of content help students focus their processing and help ease the load on short term memory. But students must believe that the test will truly be limited to the domain specified by the objective to act appropriately. These results also mean that objectives which concretely describe a test are useful cognitive tools to help students direct their attention and make decisions when students are not given a limited subject matter domain. Thus, to help students attend to the most relevant content in a reading assignment, teachers may specify either the limits of the content or the exact nature of the test.

The results about choosing relevant content may be tempered somewhat by noting that the correlation between choosing relevant content and choosing irrelevant content was relatively low (r=.21). Because the correlation was not negative, it may be said that subjects who chose relevant content also chose some irrelevant content. Subjects who selected the relevant content correctly were discriminating, but not always discriminating very precisely. Some subjects may have gone beyond the defined limits described by objectives for other reasons. This result, along with the reasons supplied by students for their choices, demonstrated that subjects use their own strategies to choose content as well as those that were suggested by instructors. Thus, objectives did not necessarily hinder subjects from looking at and possibly learning incidental content as some researchers contended (Duchastel & Brown, 1974; Frase & Kreitzberg, 1975; Rothkopf & Billington, 1975, 1979). This supports Kaplan and Rothkopf's notion (1972,1974) that objectives increase both relevant and incidental learning. This result should allay the fears of teachers who believe that giving students objectives will narrow their attention. On the contrary, students are not like computers, they have their own agendas and strategies which supplement the strategies provided by teachers.

Why did subjects choose other content beside that which was relevant to the objective? There could be many reasons. First, the subjects in this study may not be very good at choosing relevant content; they may not be very efficient learners. But this reason is not convincing because the subjects were graduate students and were probably efficient learners. Second, based on their classroom experience with teachers stating objectives which have no relation to the test, subjects may not believe that the objectives describe the test and therefore ignore them (Melton, 1978). Hamilton (1985) supported this reason when he suggested that students' experiences with objectives are a significant factor in affecting students' learning. Third, subjects may realize the limitations of describing a test through an objective and thus go beyond what the objective states to cover what they interpret as the important aspects of the subject. Fourth, subjects may be influenced by the context of the research. Several subjects commented on the importance of the concept of correlation in a general research setting. Perhaps subjects may have felt compelled to cover more about correlation than asked for in the objectives. Fifth, subjects may simply have a drive and a curiosity which influences them to go beyond the immediate objective. If students are so highly motivated, they may achieve the objectives regardless of whether or not test requirements are specified (Melton, 1978). On the other hand, perhaps because this was "just an experiment," students were not motivated to focus as accurately as they would if the test counted for a grade.

The findings and the possible reasons seem to imply that, as Melton suggested, it is not sufficient to simply provide students with behavioral objectives. Students must also understand and trust in the relationship between the objective and the test, and they must use the objective purposely to prepare for the test. Thus, teachers must first show students that the objectives describe the test, explain how to use the objective as a tool, and then follow through by providing a valid test.

Selection of Exercise

Does the presentation of application task objectives which concretely describe and exemplify a required test help students to know which exercise to select when given a choice? The result showed that there was no difference in the frequency of choosing the best exercise between the subjects with or without the concrete objective treatment.

One puzzling finding was that subjects who selected more irrelevant content were more likely to choose the right exercise. To solve this puzzle, note that subjects were given only a single example in the concrete objective treatment which may have satisfied and possibly misled them. Meanwhile, subjects who were given objectives without an example might have been motivated to check various examples in the text to clarify the task. In support of this solution the researcher observed that about half of the remarks given by subjects who chose the right exercise implied that they relied on examples in the text material rather than on the objectives. The reason for this may be due to a recent memory effect, where information processed most recently affected the students' use of examples.

Posttest Performance

Does the presentation of application task objectives which define a subject domain and exemplify a required test help students to get a higher score on the application posttest? The results showed that the defined course objective treatment substantially influenced the subjects' achievement on the posttest. Subjects given objectives which defined the subject domain were more likely to attain higher scores than subjects given objectives which did not define the subject domain as precisely.

Although the effect of the defined objectives was clear in the subjects' posttest performance, it was even clearer without outliers. The effect size of defined objectives was .5 when all the subjects were included in the analysis. Without one outlier, the effect size was .6. Without two outliers, the effect size was .7. The effect sizes, $\underline{d}$=.5, .6, and .7 indicate that observed mean differences between the defined objective treatment and the nondefined objective treatment were equivalent to .5, .6, and .7 standard deviations. In other words, the defined objective treatment group got scores one half of a standard deviation higher than the nondefined objective treatment group. Furthermore, the regression coefficients of the defined objective treatment showed that for those students in that treatment compared to those without that treatment, we would expect an increase in posttest scores of 1.46, 1.72, and 1.86 points for 56, 55, and 54 subjects respectively. On the ten item test, this means that students affected by the defined objective treatment got one and a half points or more higher than others, a substantial impact. This would be like getting 15 to 18 points more on a one hundred point test.

One finding from the preliminary analysis on the posttest score was the distribution of the scores. The posttest score was negatively skewed. That means that many subjects had scores that were close to the maximum possible score. Since the distribution of the posttest score did not justify the assumption of normality, nonparametric tests were performed to verify the parametric test results. The results showed similar outcomes to the parametric test results. The negatively skewed distribution of the posttest score also implied a ceiling effect on the score. A ceiling effect means that the range of difficulty of the test items was limited. Therefore, the test score might not measure the entire range of achievement possible on the posttest performance affected by the treatments. The ceiling effect may also influence the reliability of the posttest. Since the reliability measured the degree to which the item responses correlate with the total test score, the reliability of the posttest might be relatively low due to the ceiling effect. Thus, the ceiling effect placed an artificial restriction on the distribution of gain scores across treatments. In other words, the estimate of effect of the defined objective treatment was conservative due to a ceiling effect. The defined objective treatment probably would have produced even greater achievement than the nondefined objective treatment had the text covered a wider content area. Thus, if the posttest included more items and wider range of difficulty by expanding the content of the text material, subjects' posttest scores between treatments may have shown greater differences than the present findings.

While the defined objective treatment influenced posttest performance of an application task learned from text, the concrete objective treatment did not. The concrete objective treatment was supposed to help students to decide on the exercise which best matched the sample presented in the objectives, so they would practice the desired performance under appropriate test conditions, and therefore succeed on the test itself. But objectives with a concrete example of the test did not help students to select the best exercise. It may be that students used the example primarily to note the content domain represented and the example duplicated the help provided by the limitations of content already provided. The simple effect of the concrete objective treatment on the selection of relevant content supported the notion that students were probably using the example to define the domain. Perhaps students need to learn how to use the example to match exercise conditions and behaviors. Perhaps one example is not enough. Perhaps the example was not concrete enough to be effective. Teachers and researchers may therefore consider experimenting by providing a number of concrete examples to show the test format and by explicitly showing students the relation of these examples to the test.

Reading time

Does the presentation of application task objectives which define a subject domain and concretely exemplify a required test help students to use less time to read the text? It was thought that if students could selectively attend to only that content needed and those conditions and behaviors desired they should save time in their reading. The results showed that neither the defined nor the concrete objective treatment made any difference in reading time. In fact, subjects without the defined objective treatment who spent more time reading were as good at choosing relevant content as those given the defined objective treatment. It seems like unguided students may find relevant content accidently because they select and read everything. However, students given a defined objective treatment, may spend as much time reading to be absolutely sure they have found what they need to meet the objective. Thus, the defined objective treatment may not help students be any more efficient in terms of reading time. But, given the same reading time as those without the defined objective treatment, students with the defined objective treatment do score higher on the posttest. So, in that sense, objectives foster efficiency.

Path Analysis

The results from the correlation analysis, the parametric analysis, the nonparametric analysis, and the regression analysis were used in a path analysis to verify the theoretical model proposed in chapter III. The path diagram revealed a number of interesting significant effects on posttest performance. From the ANOVA, nonparametric, and regression analyses, it is apparent that subjects who were given the defined objective treatment were more likely to get higher posttest scores than subjects who were not given the defined objective treatment. The analysis showed a strong effect for the defined objective treatment on the posttest score. However, the path analysis showed that the defined objective treatment effect was not direct. As proposed in theoretical model, the effect was indirect through choosing relevant content and exercise performance. Thus, the path diagram supported the model proposed in this study. This result suggests that teachers should provide defined objectives, text with content relevant to the task, and appropriate exercises to produce posttest achievement. Some students, on their own, will choose the content and use the exercise to achieve. Other may have to be taught how to use the objectives to choose content and exercise.

Limitations

There were two types of limitations to this study: threats to internal validity and threats to external validity:

The internal validity of an experiment is the extent to which extraneous variables have been controlled by the researcher (Campbell & Stanley, 1963). This study has four possible threats to internal validity.

1. Subjects in this study had treatments under slightly different environmental conditions. They either participated individually or in groups up to five, each receiving his or her own treatment. Thus, some subjects may have been influenced to stop reading sooner or to continue reading because of the actions of others.

2. The researcher may have inadvertently influenced subjects' thinking by asking for reasons for their choice after they finished their reading and after they selected an exercise. For example, when subjects were asked to justify their choices of content, they may have been alerted to the notion that they needed a rationale for their choices. The rationale may have reminded them of the objectives. If they had read irrelevant as well as relevant content, being reminded of the objectives may have helped them focus an relevant content and retrieve only that content.

3. The reliability of the posttest may have affected the strength of the treatment effects. Note, that in spite of the moderate reliability, clear effects were present. If the posttest did not have a ceiling effect, the

reliability would have been greater and perhaps the treatment effects even more pronounced. For a criterion referenced task, such as this, it may have been more appropriate to use another kind of estimate of reliability.

4. The researcher administered the experiment and coded the data, and the qualitative data were analyzed by the researcher and researcher's adviser. These procedures might have caused experimenter bias. For those who would like to check the results of the qualitative measures, the subjects' verbal responses are recorded in Appendix L and M.

External validity is the extent to which the findings of an experiment can be applied to particular settings (Campbell & Stanley, 1963). This study has three possible threats to external validity.

1. One must be cautious about generalizing the results of this study due to the nature of the subjects of this study: a volunteer sample of graduate students at one university. Graduate students may learn from text in ways unlike undergraduates, high school, or elementary school students

2. Generalization may also be limited by the environmental conditions of this study. This experiment was an isolated learning situation outside of a regular class. Perhaps learners would learn application tasks from text differently in the context of a real class.

3. The moderate reliability of the posttest may affect the generalization of findings in this study. It may be that other subjects

taking this posttest may get a somewhat diminished or increased score simply due to test characteristics.

Conclusions

Keeping in mind the limitations, the following four conclusions are supported by the findings.

1. Students presented with specifically defined objectives were able to select relevant content for an application task to be learned from text. Specifically defined objectives help students most when there is no concrete example of the test. In contrast, in general, students presented with the concrete objective treatment were not any more able to select relevant content from text for an application task than students without them. However, when students were not presented with limits of the content to be learned, concrete examples of a test helped students to select relevant content. In addition, objectives did not restrict or inhibit students from learning content incidental to that prescribed by the objectives. Though students thought about objectives when selecting relevant content, the objectives were not the only criteria they used to study. Subjects also used their own criteria. Therefore, it is recommended that to serve as a guide for students' selection of content from text for an application task, teachers should include in their objectives statements which define the limits of the content to be tested. If the content cannot be defined, then teachers should include a concrete example of the test. Also teachers should not be surprised when students use their own criteria to attend to content irrelevant to the objectives.

2. Students presented with the concrete objective treatment were no different than students presented without the concrete objective treatment in selecting the right exercise for preparing for a posttest of an application task learned from text. Therefore, it cannot be recommended on the basis of this study that teachers guide students in selecting the best practice for an application task learned from text by providing only a single example of the test task in the objective.

3. Students' posttest performance on an application task learned from text was positively and substantially affected by the defined objective treatment. Although the reliability of the posttest was moderate, the results clearly showed a substantial effect of definition. Therefore, it is recommended that to affect the number of posttest items answered correctly for an application task learned from text, teachers should include in their objectives a definition of the limits of content to be tested. The concrete objective treatment did not produce a significant effect on students' achievement. Perhaps this is so because more than one example is needed to help students' selection of the best practice for a test. However, the concreteness showed its potential effectiveness by acting as a definer when the content was not defined.

4. Students presented with the defined objective treatment were not different in their reading time than students without them. Neither were the students presented with the concrete objective treatment. Students seemed to think about objectives especially when selecting relevant content. But, the objectives were not the only criteria they used to study. Subjects

used their own criteria in addition to objectives. Therefore, It is recommended that teachers find tools and techniques other than objectives to influence reading time.

Implications of the Study for Instructional Design

Two unique aspects of this study were investigating application objectives and students' thinking as they used objectives while learning. Each aspect has implications for instructional design.

Application Objectives

This study showed that objectives with certain characteristics could be as effective in influencing posttest results on an application task as well as influencing posttest results on recall tasks as reported in previous studies (Duchastel, 1980; Ho, Savenye, & Haas, 1986; Kaplan & Rothkopf, 1974; Rothkopf & Kaplan, 1972). But teachers need to state objectives differently for application tasks than recall tasks. The findings showed that teachers should consider including a clear definition of the content domain in application objectives, and they should experiment with concrete examples of test items in the objectives.

Some educators may be concerned about "teaching for the test", implying that the objective will just assist recall and that incidental learning will be neglected. As just mentioned, this study showed that telling students what the objective is will not merely produce recall, it will aid in learning of application tasks. However, in addition, this study demonstrated that giving students objectives will not restrict their learning. They will continue to learn incidental content.

Students' Use of Objectives

Researchers on objectives have said that selective attention plays an important role in the way students use objectives (Reynold & Anderson, 1982; Reynold & Shirey, 1988; Wittrock, 1986). However, they failed to show what selective attention means and how students use it. This study showed that students use more than one criterion to direct their attention. They use objectives, but they also use text examples and their own prior experience to select content.

The findings of this study imply that teachers should consider providing defined and concrete objectives, relevant text, and proper exercises for learning application tasks from text. Then students will be able to use the objectives as in this study to properly process information. However, it is probably not sufficient to simply provide students with objectives. They must be instructed to use them efficiently.

Design Implications

Providing objectives, relevant text content, and exercises can help teachers plan for students' learning in elementary school, high school, and college. Instructional designers may also create computer-aided-instruction (CAI) and individual modules using the same design features as in a typical text assignment.

To produce achievement of application tasks when learning from text, teachers can match the experimental protocol which is similar to typical school assignments. For example, suppose an elementary school teacher wanted to have students learn from text how to interpret a map. According to the results of this study, the teacher should assign text which states how to interpret maps and give exercises which match defined and concrete objectives like this one: Given a map such as the one on page 45 of the text, you will state the distance between any two given points such as "What is the distance between Oscoda, MI and Detroit, MI." Also suppose a high school teacher wanted to have students learn from text how to identify impressionistic art. According to the results of this study, the high school teacher should assign text which states how to identify impressionistic art and give exercises which match defined and concrete objectives like this one: Given a painting not seen in the text such Van Gogh's Starry night, you will state the characteristics of that painting which are characteristic of impressionistic style. Also suppose a college professor wanted to have students learn from text how to predict the cost of a product using supply and demand. The college professor should assign text which states how to predict the cost of a product using supply and demand and give exercises which match defined and concrete objectives like this one: Given data such as that on page 56 of the text that show estimated demand and supply of world petroleum in 1993, you will predict the cost of the petroleum in 1993.

Recommendations for Future Study

There are eight recommendations for future studies:

1. Expand the content of the text material to be learned for an application task to produce a greater effect of the defined objective treatment. The present study was planned to take about 30 minutes of time in consideration of the subjects' possible fatigue. As a result, the researcher limited the length of text material and posttest items. These limitations might have resulted in a limited treatment effect as well as limited differentiation among treatment groups.

2. Replicate the study with a larger number of posttest items. Increasing the number of posttest items may be desirable to improve the reliability of the posttest as well as to measure the treatment effect more precisely.

3. Replicate the study with different levels of students. It should reveal whether these results are a characteristic of only graduate students or whether they apply to elementary, junior high, senior high, and undergraduate students as well.

4. Include more examples as well as nonexamples of the test task in the concrete objective treatment. Additional varied examples are likely to produce a treatment effect for concreteness.

5. Conduct the research in an actual classroom setting to produce the natural behaviors of learners.

6. Conduct the research with other application tasks with more complex content. Consider other analysis, synthesis, and problem solving tasks.

7. Conduct research that repeats the treatment with variation in content.

8. Extend the type of instruction to other methods than text. Perhaps a video lecture or an audio tape can be used as the method of instruction.

LIST OF REFERENCES

Anderson, J. (1980). *Cognitive psychology and its implications*. San Francisco: Freeman.

Anderson, R. (1982). Allocation of attention during reading. In A. Flammer & W. Kintsch (Eds.), *Discourse processing* (pp. 292-305). New York: North-Holland.

Anderson, R., & Faust, G. (1974). *Educational psychology: The science of instruction and learning*. New York: Dodd, Mead.

Barker, D., & Hapkiewicz, W. (1979). The effects of behavioral objectives on relevant and incidental learning at two levels of Bloom's taxonomy. *Journal of Educational Research, 72*, 334-339.

Boker, J. (1974). Immediate and delayed retention effects of interspersing questions in written instructional passages. *Journal of Educational Psychology, 66*, 96-98.

Borg, W., Gall, M. (1983). *Educational researcher: An introduction* (4th ed.). New York: Longman.

Brown, A. (1980). Metacognitive development and reading. In J. Spiro, B. Bruce, & W. Brewer (Eds.), *Theoretical issues in reading comprehension* (pp. 453-481). Hillsdale, N.J.: Erlbaum.

Brown, A., Bransford, J., Ferrara, R., & Campione, J. (1984). Learning, remembering, and understanding. In J. Flavell & E. Markman (Eds.), *Handbook of child psychology* (Vol. III, pp.77-166). New York: Wiley.

Brown, A., Campione, J., & Day, J. (1981). Learning to learn: On training students to learn from texts. *Educational researcher, 10*, 14-21.

Brown, A., & Day, J. (1983). Macrorules for summarizing texts: The development of expertise. *Journal of Verbal Learning and Verbal Behavior, 22*, 1-14.

Brown, A., & Smiley, S. (1978). The development of strategies for Studying texts. *Child Development, 49*, 1076-1088.

Calfee, R., & Drum, P. (1986). Research on teaching reading. In M. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 804-849). New York: Macmillan.

Campbell, T., & Stanley, J. (1963). Experimental and quasi-experimental designs for research on teaching. In N. Gage (Ed.), *Handbook of research on teaching* (pp. 171-246). Chicago: Rand McNally.

Collins, A. (1977). Processes in acquiring knowledge. In R. Anderson, R. Spiro, & W. Montague (Eds.), *Schooling and the acquisition of knowledge* (pp. 339-363). Hillsdale, N.J.: Lawrence Erlbaum.

Collins, A., & Stevens, A. (1983). A cognitive theory of inquiry learning. In C. Reigeluth (Ed.), *Instructional-design theories and models: An overview of their current status* (pp. 247-278). Hillsdale, N.J.: Erlbaum.

Dalis, G. (1970). Effect of precise objectives upon student achievement in health education. *The Journal of Experimental Education, 39*, 20-23.

Davis, R., Alexander, L., & Yelon, S. (1974). *Learning system design: An approach to the improvement of instruction.* New York: McGraw-Hill.

Duchastel, P. (1980). Learning objectives and the organization of prose. *Journal of Educational Psychology, 72*, 300-309.

Duchastel, P. (1977). *Functions of instructional objectives: Organization and direction.* Great Britain: the Open University. (ERIC Documentation Reproduction Service No. ED 135 774)

Duchastel, P., & Brown, B. (1974). Incidental and relevant learning with instructional objectives. *Journal of Educational Psychology. 66*, 481-485

Duell, O. (1974). Effect of type of objective, level of test question, and judged importance of test material upon posttest performance. *Journal of Educational Psychology, 66*, 225-232.

Felker, D., & Dapra, R. (1975). Effects of question type and question placement on problem solving ability from prose material. *Journal of Educational Psychology, 67*, 380-384.

Frase, L. (1968). Effect of question location, pacing, and mode upon retention of prose material. *Journal of Educational Psychology, 59,* 244-249.

Frase, L., & Kreitzberg, V. (1975). Effects of topical and indirect learning directions on prose recall. *Journal of Educational Psychology, 67,* 320-324.

Glass, G., & Hopkins, K. (1984). *Statistical methods in education and psychology* (2nd ed.). Englewood Cliffs, N.J.: Prentice Hall.

Glover, J., Plake, B., & Zimmer, J. (1982). Distinctiveness of encoding and memory for learning tasks. *Journal of Educational Psychology, 74,* 189-198.

Guthrie, J. (1988). Locating information in documents: Examination of a cognitive model. *Reading Research Quarterly, 23,* 178-199.

Guthrie, J., & Kirsch, I. (1987). Distinctions between reading comprehension and locating information in text. *Journal of Educational Psychology, 79,* 220-227.

Hagen, J., & Hale, G. (1973). The development of attention in children. In A. Pick (Ed.), *Minnesota symposia on child psychology* (Vol. 7, pp. 117-140).

Hamaker, C. (1986). The effects of adjunct questions on prose learning. *Review of Educational Research, 56,* 212-242.

Hamilton, R. (1985). A framework for the evaluation of the effectiveness of adjunct questions and objectives. *Review of Educational Research, 55,* 47-85.

Hannafin, M. (1987). The effects of orienting activities, cueing, and practice on learning of computer-based instruction. *Journal of Educational Research, 81,* 48-53.

Harwell, M. (1988). *Choosing between parametric and nonparametric tests.* Unpublished manuscript.

Hedrick, C. (1976). Learning production systems from examples. *Artificial Intelligence, 7,* 21-49.

Ho, C., Savenye, W., & Haas, N. (1986). The effects of orienting objectives and review on learning form interactive video. *Journal of Computer-Based Instruction, 13*, 126-129.

Just, M., & Carpenter, P. (1987). *The psychology of reading and language comprehension.* Newton, MA: Allyn and Bacon.

Kaplan, R. (1974). Effects of learning prose with part versus whole presentations of instructional objectives. *Journal of Educational Psychology, 66*, 787-792.

Kaplan, R., & Rothkopf, E. (1974). Instructional objectives as directions to learners: Effects of passage length and amount of objective-relevant content. *Journal of Educational Psychology, 66*, 448-456.

Kaplan, R., & Simmons, F. (1974). Effects of instructional objectives used as orienting stimuli or as summary/review upon prose learning. *Journal of Educational Psychology, 66*, 614-622.

Kauer, K. (1984). Intentional and incidental learning with instructional texts: A meta-analysis for 1970-1980. *American Educational Research Journal, 21*, 323-339.

Kibler, R., & Bassett, R. (1977). Writing performance objectives. In L. Briggs (Ed.), *Instructional design: Principles and applications* (pp. 49-95). Englewood Cliffs, N.J.: Educational Technology Publications.

Lewis, J. (1981). Answers to twenty questions on behavioral objectives. *Educational Technology, 21*, 27-31.

Lyon, M., & Gettinger, M. (1985). Differences in student performance on knowledge, comprehension, and application tasks. *Journal of Educational Psychology, 77*, 12-19.

Mager, R. (1962). *Preparing instructional objectives*. Palo Alto, CA: Fearon.

Mayer, R. (1984). Aids to text comprehension. *Educational Psychologist, 19*, 30-42.

Mehrens, W., & Lehmann, I. (1984). *Measurement and evaluation in education and psychology* (3rd ed.). New York: Holt, Rinehart, and Winston.

Melton, R. (1978). Resolution of conflicting claims concerning the effects of behavioral objectives on student learning. *Review of Educational Research, 48*, 291-302.

Miller, P., & Weiss, M. (1981). Children's attention allocation, understanding of attention, and performance on the incidental learning task. *Child Development, 52*, 1183-1190.

Nitch, K. (1977). *Structuring decontextualized forms of knowledge.* Unpublished doctoral dissertation, Vanderbilt University.

Palincsar, A., & Brown, A. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction, 1*, 117-175.

Peterson, P., Swing, S., Bravermann, M., & Buss,R. (1982). Students' aptitudes and their report of cognitive processes during direct instruction. *Journal of Educational Psychology, 74*, 535-547.

Peterson, P., Swing, S., Stark, K., & Waas, G. (1984). Students' cognitions and time on task during mathematics instruction. *American Educational Research Journal, 21*, 487-515.

Pressley, M., Goodchild, F., Fleet, J., Zajchowski, R., & Evans, E. (1989). The challenges of classroom strategy instruction. *The Elementary School Journal, 89*, 301- 342.

Reynolds, R., & Anderson, R. (1982). Influence of questions on the allocation of attention during reading. *Journal of Educational Psychology, 74*, 623-632.

Reynolds, R., & Shirey, L. (1988). The role of attention in studying and learning. In C. Weinstein, E. Goetz, & P. Alexander (Eds.), *Learning and study strategies: Issues in assessment, instruction, and evaluation* (pp. 77-100). New York: Academic press.

Reynolds, R., Standiford, S., & Anderson, R. (1979). Distribution of reading time when questions are asked about a restricted category of text information. *Journal of Educational Psychology, 71*, 183-190.

Rosch, E. (1978). Principles of categorization. In E. Rosch, & B. Lloyd (Eds.), *Cognition and categorization* (pp. 9-31). Hillsdale, N.J.:

Erlbaum.

Rothkopf, E. (1965). Some theoretical and experimental approaches to problems in written instruction. In J. Krumboltz (Ed.), *Learning and the educational process* (pp. 193-221). Chicago: Rand McNally.

Rothkopf, E., & Billington, M. (1979). Goal-guided learning from text: Inferring a descriptive processing model from inspection times and eye movements. *Journal of Educational Psychology, 71*, 310-327.

Rothkopf, E., & Billington, M. (1975). Relevance and similarity of text elements to descriptions of learning goals. *Journal of Educational Psychology, 67*, 745-750.

Rothkopf, E., & Kaplan, R. (1972). Exploration of the effects of density and specificity of instructional objectives on learning from text. *Journal of Educational Psychology, 63*, 295-302.

Rutter, M. (1989). Attention deficit disorder/Hyperkinetic syndrome: Conceptual and research issues regarding diagnosis and classification. In T. Sagroden, & T. Archer (Eds.), *Attention deficit disorder: Clinical and basic research* (pp. 1-24). Hillsdale, N.J.: Erlbaum.

Shirey, L., & Reynolds, R. (1988). Effect of interest on attention and learning. *Journal of Educational Psychology, 80*, 159-166.

Siegel, I., & Saunders, R. (1979). An inquiry into inquiry: Question asking as an instructional model. In L. Katz (Ed.), *Current topics in early childhood education* (pp. 169-193). Norwood, N.J.: Ablex.

Stein, B. (1978). Depth of processing reexamined: The effects of the precision of encoding and text appropriateness. *Journal of Verbal Learning and Verbal Behavior, 17*, 707-714.

Tennyson, R., & Park, O. (1980). The teaching of concepts: A review of instructional design literature. *Review of Educational Research, 50*, 55-70.

Tennyson, R., Cocchiarella, M. (1986). An empirically based instructional design theory for teaching concepts. *Review of Educational Research, 56*, 40-71.

VanLehn, K. (1985). Learning one subprocedure per lesson. Unpublished manuscript.

Watts, F., & Anderson, R. (1971). Effects of three types of inserted questions on learning from prose. *Journal of Educational Psychology, 62*, 387-394.

Weinstein, C., & Mayer, R. (1986). The teaching of learning strategies. In M. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 315-327). New York: Macmillan.

Wittrock, M. (1986). Students' thought processes. In M. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 297-314). New York: Macmillan.

Yelon, S. (1991). Writing and using instructional objectives. In L. Briggs, K. Gustafson, & M. Tilman (Eds.). *Instructional design: Principles and applications* (2nd ed., pp. 75-121). Englewood Cliffs, N.J.: Educational Technology Publications.

APPENDICES

APPENDIX A

Invitation to Volunteer to Participate

Hello:

Want a chance to help with some research on instructional psychology, and learn more about learning skills and statistical knowledge? How? Well, more details will be provided if you decide to participate, but the basic idea involves taking something like a short course. Approximately 30 minutes will be needed.

To indicate your interest in participating, please print your name and telephone number on this sheet and return it to me. Even if you volunteer, you will be free to decline to participate if you happen to change your mind. Thank you for your consideration,

Jun Young Shin

Graduate Student

Yes, I would like to be considered:

Name ________________________________

Phone Number ______________________________

If you have any questions or concerns, contact Jun Young Shin (Tel. 355-3012).

APPENDIX B

Informed Consent Form

Prior to signing this form, please read all of the following paragraphs. The paragraphs are numbered to make it easier to ask questions about specific points.

1. This research in which you would participate is being conducted to fulfill one of the requirements of Jun Young Shin's doctoral program at Michigan State University. The purpose of the research is to study the effects of communicating course requirements on students' learning processes and achievement. There will be four types of course requirements. You will be randomly assigned into one of them and you will be asked to read a course requirement and text material, and to complete an exercise and posttest. Participation in this study will require approximately 30 minutes of your time. The time can be at your convenience - any time, any day that is open.
2. Signing this form expresses your agreement both that the research has been explained to you and you understand the explanation. Please note that this research involves all the risks usually associated with taking a test including both the risk of stress while answering the questions and the risk that one's performance may not meet one's expectations.
3. Please note that no beneficial effects are guaranteed for participating this research.
4. Please note that, even if you agree to participate, you may end your participation at any time without fear of reprisal.
5. All results of this study will be treated with strict confidence regarding the identity of any participant. Individual participant will be able to obtain their own results if they wish.
6. Signing this form expresses your agreement that the results of your posttest will be shared with the researcher in order to give an understanding of your learning.
7. Signing this form will indicate that you have freely consented to participate in the research referred to in the preceding paragraphs. If you so agree, please sign and date this form in the space provided below

______________________Participant's Signature Date____________

APPENDIX C

Confidentiality

The following procedures will be used to protect confidentiality which will be assured to each potential subject. Only the researcher and trained raters will have access to the posttest results and questions used in the study. Each posttest and question sheet will be numbered and will not contain the name of the subject.All responses sheets will be transformed to number codes for the purpose of computer analysis. Information from the study will be treated in aggregate and it will not be possible to identify any individual taking part in the study or the responses that they have made. The names of the individual subjects or collection sites will not be used in any reports of the results of this research.

APPENDIX D

Prequestions

Please answer these questions by checking the appropriate space.

1. Have you ever taken any course that taught you about correlation?

Yes____ No____

If yes, which course? _______________

2. How well do you understand the meaning of correlation?

________	________	________	________	________
very well	well	adequately	poorly	very poorly

3. How well can you calculate correlation?

________	________	________	________	________
very well	well	adequately	poorly	very poorly

4. How well can you use correlation ideas?

________	________	________	________	________
very well	well	adequately	poorly	very poorly

5. Have you ever taken any course that taught you about instructional objectives?

Yes____ No____

If yes, which course? _______________

6. How well do you understand the meaning of instructional objectives?

________	________	________	________	________
very well	well	adequately	poorly	very poorly

7. How well can you derive and write instructional objectives?

___	___	___	___	___
very well	well	adequately	poorly	very poorly

8. How well can you apply ideas about instructional objectives?

___	___	___	___	___
very well	well	adequately	poorly	very poorly

9. I am in the following sort of program.

___	___	___	___
BA	MA	ED.S.	Ph.D.

Subject ______________________________

APPENDIX E

Instructional Objective

Read These Important Instructions:

1. Today you will read and learn about correlation.
2. You will be given a posttest after reading some text and doing a practice exercise. The posttest will assess your attainment of the instructional objective.
3. The instructional objective below describe the posttest you will get after reading and practice.
4. The instructional objective describes what you are to learn from the text you will be given to read.
5. Consider the instructional objective careful, so
   a. you can direct your attention to the most relevant content,
   b. and you can choose the best approach to practice.
6. You do not have to read all the content - just read what you need to do well on the posttest. Read selectively.

Instructional Objective (Test Description)

Read very carefully.

1. On the test you will be given data regarding only combinations of continuous and artificial dichotomy variables, such as:

Student	SAT Scores	Algebra Test (Success=1; Failure=0)
Borg	350	0
Smith	450	1
etc.		

2. On the test you will be given only these choices:
   a. Pearson product-moment correlation
   b. Biserial correlation
   c. Tetrachoric correlation
3. On the test you are to circle the name of the appropriate correlation technique.

On the next page you will find the text relating to the test you will take.

Read These Important Instructions:

1. Today you will read and learn about correlation.
2. You will be given a posttest after reading some text and doing a practice exercise. The posttest will assess your attainment of the instructional objective.
3. The instructional objective below describe the posttest you will get after reading and practice.
4. The instructional objective describes what you are to learn from the text you will be given to read.
5. Consider the instructional objective careful, so
   a. you can direct your attention to the most relevant content,
   b. and you can choose the best approach to practice.

6. You do not have to read all the content - just read what you need to do well on the posttest. Read selectively.

Instructional Objective (Test Description)

Read very carefully

1. On the test you will be given data regarding only combinations of continuous and artificial dichotomy variables.

2. On the test you will be given only these choices:

   a. Pearson product-moment correlation
   b. Biserial correlation
   c. Tetrachoric correlation

3. On the test you are to circle the name of the appropriate correlation technique.

On the next page you will find the text relating to the test you will take.

Read These Important Instructions:

1. Today you will read and learn about correlation.
2. You will be given a posttest after reading some text and doing a practice exercise. The posttest will assess your attainment of the instructional objective.
3. The instructional objective below describe the posttest you will get after reading and practice.
4. The instructional objective describes what you are to learn from the text you will be given to read.
5. Consider the instructional objective careful, so
   a. you can direct your attention to the most relevant content,
   b. and you can choose the best approach to practice.
6. You do not have to read all the content - just read what you need to do well on the posttest. Read selectively.

Instructional Objective (Test Description)

Read very carefully

1. On the test you will be given some data, such as:

Student	SAT Score	College GPA
Zimmerman	350	3.7
Spalding	450	3.2
etc.		

2. On the test you will be given a list of techniques given such as

   a. Pearson product-moment correlation
   b. Biserial correlation
   c. Tetrachoric correlation

3. On the test you are to circle the name of the appropriate statistical technique.

On the next page you will find the text relating to the test you will take.

Read These Important Instructions:

1. Today you will read and learn about correlation.
2. You will be given a posttest after reading some text and doing a practice exercise. The posttest will assess your attainment of the instructional objective.
3. The instructional objective below describe the posttest you will get after reading and practice.
4. The instructional objective describes what you are to learn from the text you will be given to read.
5. Consider the instructional objective careful, so
   a. you can direct your attention to the most relevant content,
   b. and you can choose the best approach to practice.
6. You do not have to read all the content - just read what you need to do well on the posttest. Read selectively.

Instructional Objective (Test Description)

Read very carefully

1. On the test you are to know when to use correlational techniques.

On the next page you will find the text relating to the test you will take.

APPENDIX F

Text

Instructions:

1. Read the following text to prepare yourself to take a posttest described by the objective.
2. You are not responsible for reading all paragraphs.
3. Direct your attention to the content you feel is most important to help you prepare for the posttest.
4. Please check using the marker given to you only paragraphs that are related to the instructional objective. For example, if you feel that following paragraph is important content, check the left top blank as follows:

   X A. Correlational techniques are frequently used in statistical analyses.

5. Take time as much as possible until you master the important content.
6. The posttest will be closed book test.

Correlation Techniques

___ A. In this section we discuss seven correlational techniques that can be used to analyze the degree of relationship between two variables. The purpose of the correlation coefficient is to express in mathematical terms the degree of relationship between any two variables. A coefficient of correlation is a statistical summary of the degree and direction of relationship between two variables. A perfectly consistent relationship is expressed as 1.0. The form of the variables to be correlated and the nature of the relationship determine which technique is used. Variables in relationship studies are usually expressed in one of four forms: continuous, rank, artificial dichotomy, and true dichotomy.

___ B. Continuous scores are values of a variable that has an indefinite number of points along its continuum. For example, these data,

Student	Stanford-Binet Intelligence Test
Fuson	142
Gelman	137
Harel	126
etc.	

would be continuous scores.

___ C. A rank score expresses the position of a person or object on a variable, relative to the positions held by other persons or objects. For example, these data,

Country	Speed limit	Ranks
Italy	87mph	1
France	81mph	2
U. S.	65mph	3
etc.		

would be rank scores.

___ D. The term dichotomy refers to a variable that has only two values. An artificial dichotomy results when individuals are placed into two categories on the basis of difference on a continuous variable. For example, these data,

Student	Socioeconomic Status (High=1; Low=0)
Inhelder	1
Zucker	0
Rochel	0
etc.	

would be artificial dichotomy scores. When individuals are divided into two groups on the basis of a variable that can have only two values, the dichotomy is referred to as a true dichotomy. For example, these data,

Student	Marital Status (Married=1; Not Married=0)
Sawyer	1
Taylor	0
Stanley	1
etc.	

would be true dichotomy scores.

Pearson Product-Moment Correlation, r

___ E. The Pearson product-moment coefficient, r, is used when both variables that we wish to correlate are expressed as continuous scores. For example, if we administer an intelligence test such as the Stanford-

Binet test and an achievement test such as the CTBS Achievement Test to the same group of individuals, we will have two sets of continuous scores, each individual having a score on each of the two tests. The data may look like this:

Student	Stanford-Binet	CTBS Achievement Test
Glass	120	560
Grant	135	470
Allison	127	640
etc.		

The relationship between these two sets of scores would be expressed by a product-moment coefficient of .35. Because most educational measures yield continuous scores, this is the most frequently used correlational technique. The product-moment correlation has a smaller standard error than the other correlational techniques and is generally preferred when appropriate.

Rank-Difference Correlation, rho

___ F. The rank-difference correlation, rho, is a special form of the product-moment correlation. The rank-difference correlation is used to correlate two variables when one or both of these variables are available only in rank form. For example, studies correlating speed limit with traffic fatalities over the world would generally employ the rank-difference correlation because each country's standing is expressed as a rank. To use this correlational technique, however, both variables must be expressed as a rank, so in this case the speed limit of each country and fatalities, which are available in the form of continuous scores, would have to be converted to ranks before the correlation could be calculated. Converting continuous scores to rank scores involves the simple procedure of listing the continuous scores in order of magnitude and then assigning ranks. The data may look like this:

Country	Speed Limit (X)	Fatalities (Y)	X	Y
Italy	87 mph	6.4	1	3
France	81 mph	8.0	2	2
U.S.A.	65 mph	3.3	3	4
Spain	62 mph	12.4	4	1
etc.				

Kendall's tau

___ G. Tau is another form of rank correlation that has some theoretical advantage over the better known Spearman's rho. Like rho, tau is used to correlate two sets of ranks. The data may look similar to that used in the explanation of rho. Data not in rank form can be converted to ranks if one desires to use tau. Its principal advantage is that it has a more normal sampling distribution than rho for a sample under ten. It is more difficult to calculate than rho and yields lower correlation coefficients when computed from the same data.

The Biserial Correlation

___ H. The biserial correlation is used when one of the variables is in the form of continuous scores and the other variable is in the form of an artificial dichotomy. For example, if we wish to determine the relationship between success and failure in algebra course and scores on an algebra aptitude test, we would use the biserial correlation. The data may look like this:

Student	Algebra Aptitude Test Score	Success of Algebra Course (Success=1; Failure=0)
Lewis	350	0
Morgan	470	1
Morse	510	1
etc.		

In this case the aptitude test yields continuous scores, while the record of each subject as having passed or failed algebra takes the form of an artificial dichotomy. As a rule, the correlation coefficients obtained using the biserial technique are somewhat higher than those obtained on the same data using the product-moment technique.

The Point Biserial Correlation

___ I. The point biserial correlation is used when one of the variables we wish to correlate is in the form of a continuous score and the other variable is in the form of a true dichotomy. This type of correlation is used in studies relating gender to different continuous variables, such as intelligence, verbal fluency, reading ability, and achievement. In such studies gender provides the true dichotomy, and the other measure provides the continuous variable. The data may look like this:

Student	SAT Score	Gender (Male=1; Female=0)
Adams	620	0
Berk	420	1
Jackson	550	1
etc.		

The Tetrachoric Correlation

___ J. Occasionally we encounter a situation in educational research where both variables that we wish to correlate are in the form of artificial dichotomies. Under this conditions the tetrachoric correlation statistic is used. Use of this coefficient requires the assumption that the variables underlying the dichotomies in the tetrachoric correlation analysis are continuous and normally distributed. Also, the tetrachoric coefficient is considerably less stable than the product-moment coefficient. The data may look like this:

Student	Socio-Economic Status (High=1; Low=0)	Success of Algebra Course (Success=1; Failure=0)
Bennett	1	0
Duke	1	0
Cooper	o	1
etc.		

The Phi Coefficient

___ K. The phi coefficient is used to correlate two variables that are both true dichotomies. Because we deal with relatively few true dichotomies in education, phi coefficients are seldom calculated in educational research. The main use of this technique is to determine the correlation between two items on a test during item analysis. Each subject's response to each item can be classified as either correct or incorrect, thus giving two true dichotomies. The data may look like this:

Student	Marital Status (Married=1; Not Married=0)	Drop Out of College (Dropped Out=1; Remained=0)
Davis	0	1
Eder	0	0
Metz	1	1
etc.		

<u>When you are finished reading, raise your hand and ask for an exercise</u>

APPENDIX G

Questions

For the Selection of Text Content

Why did you choose and highlight the content you did as the most relevant?

APPENDIX H

Sample of Test Items

Instruction: Choose the type of test item that will best prepare you for the test. There are four exercise types. Read them and tell the proctor which exercise you wish to use.

---

1. Here is some data:

Country	Rank of Area	Rank of GNP
U.S.A.	4	1
Russia	1	4
India	6	26
(30 countries more)		
etc.		

circle the name of the appropriate statistical technique from these choices:
a. Rank-difference correlation
b. Kendall's Tau
c. Point biserial correlation
d. Phi coefficient

---

2. Here is some data:

Student	College GPA	Socioeconomic Status (High=1; Low=0)
Jackson	3.2	1
Wayne	2.4	0
Wagner	2.9	1
etc.		

circle the name of the appropriate correlation technique from these choices:
a. Pearson product-moment correlation
b. Biserial correlation
c. Tetrachoric correlation

---

3. A biserial correlation is to be used when relating two artificial dichotomy variables.
True _____ False _____

---

4. Kendall's tau has a more normal sampling distribution than rho for a sample under ten.
True _____ False _____

APPENDIX I

For the Selection of Exercise

Why did you select the exercise you did ?

APPENDIX J

Exercise Form A

1. Here is some data:

Student	GRE scores	Socioeconomic Status (High=1; Low=0)
Anderson	350	1
McLeod	450	0
Short	550	1
etc.		

circle the name of the appropriate correlation technique from these choices:
a. Pearson product-moment correlation
b. Biserial correlation
c. Tetrachoric correlation

2. Here is some data:

Student	MEAP Test Scores	College GPA
Ross	470	3.0
Warren	360	2.7
Rutter	420	3.2
etc.		

circle the name of the appropriate correlation technique from these choices:
a. Pearson product-moment correlation
b. Biserial correlation
c. Tetrachoric correlation

3. Here is some data:

Student	Stress Levels(High=1; low=0)	Anxiety Levels(High=1; Low=0)
Tanner	1	1
Sinclair	0	1
Potter	1	0
etc.		

circle the name of the appropriate correlation technique from these choices:
a. Pearson product-moment correlation
b. Biserial correlation
c. Tetrachoric correlation

Exercise Form B

1. A tetrachoric correlation is to be used when relating two artificial dichotomy variables.
   True _____ False _____

2. A Pearson product-moment correlation is to be used when relating two continuous variables.
   True _____ False _____

3. A biserial correlation is to be used when relating a continuous variable with an artificial dichotomy variable.
   True _____ False _____

Exercise Form C

1. Here is some data:

Country	Rank of Area	Rank of Population
China	2	1
Russia	1	2
Brazil	3	3
(30 countries more)		
etc.		

circle the name of the appropriate statistical technique from these choices:
a. Rank-difference correlation
b. Kendall's Tau
c. Point biserial correlation
d. Phi coefficient

2. Here is some data:

Student	SAT scores	Gender (Male=1; Female=0)
Gordon	556	1
Jones	550	0
Leeper	480	1
etc.		

circle the name of the appropriate statistical technique from these choices:
a. Rank-difference correlation
b. Kendall's Tau
c. Point biserial correlation
d. Phi coefficient

3. Here is some data:

Student	Gender (Male=1; Female=0)	Drop Out of College (Dropout=1; Remained=0)
Green	0	0
Evert	1	0
Carter	1	1
etc.		

circle the name of the appropriate statistical technique from these choices:
a. Rank-difference correlation
b. Kendall's Tau
c. Point biserial correlation
d. Phi coefficient

Exercise Form D

1. Biserial correlations are somewhat lower than those obtained on the same data using the Pearson product-moment correlation.
   True _____ False _____

2. Tetrachoric correlation is considerably less stable than the Pearson product-moment correlation.
   True _____ False _____

3. Kendall's tau is more likely to be misinterpreted than rho.
   True _____ False _____

APPENDIX K

Posttest

1. Here is some data:

People	Annual Income	Annual Saving
Duke	$ 30,000	$ 3,000
Cazden	$ 54,000	$ 4,000
Calfee	$ 43,000	$ 5,000
etc.		

circle the name of the appropriate correlation technique from these choices:
a. Pearson product-moment correlation
b. Biserial correlation
c. Tetrachoric correlation

2. Here is some data:

Country	Population (unit: million)	Number of Soldier (unit: million)
USSR	220	5.12
Britain	50	0.32
Germany	60	0.45
etc.		

circle the name of the appropriate correlation technique from these choices:
a. Pearson product-moment correlation
b. Biserial correlation
c. Tetrachoric correlation

3. Here is some data:

Country	Degree of Industrial Development (Developed=1; Underdeveloped=0)	Welfare (Good=1; Poor=0)
A	1	1
B	1	0
C	0	0
etc.		

circle the name of the appropriate correlation technique from these choices:
a. Pearson product-moment correlation
b. Biserial correlation
c. Tetrachoric correlation

4. Here is some data:

Student	Satisfaction of Home Environment (Satisfied=1; Unsatisfied=0)	GPA
Cooper	1	3.7
Lein	0	2.6
Heath	1	3.1
etc.		

circle the name of the appropriate correlation technique from these choices:
a. Pearson product-moment correlation
b. Biserial correlation
c. Tetrachoric correlation

5. Here is some data:

Baseball Player	Batting Average	Years in Major League
Miller	.327	3
White	.287	7
Enos	.252	2
etc.		

circle the name of the appropriate correlation technique from these choices:
a. Pearson product-moment correlation
b. Biserial correlation
c. Tetrachoric correlation

6. Here is some data:

People	Approval of Abortion (Agree=1; Disagree=0)	Home Environment (Good=1; Poor=0)

Keddie	1	1
Wells	0	1
Woods	0	0
etc.		

circle the name of the appropriate correlation technique from these choices:
a. Pearson product-moment correlation
b. Biserial correlation
c. Tetrachoric correlation

7. Here is some data:

People	Legalization of Marijuana (Agree=1; Disagree=0)	Socioeconomic Status (High=1; Low=0)
Wild	1	1
Zacks	1	0
Eder	0	0
etc.		

circle the name of the appropriate correlation technique from these choices:
a. Pearson product-moment correlation
b. Biserial correlation
c. Tetrachoric correlation

8. Here is some data:

Country	Average Height at 18	Welfare (Good=1; Poor=0)
A	172 cm	1
B	168 cm	0
C	173 cm	1
etc.		

circle the name of the appropriate correlation technique from these choices:
a. Pearson product-moment correlation
b. Biserial correlation
c. Tetrachoric correlation

9. Here is some data:

Family	Number of child	Socioeconomic Status (High=1; Low=0)
Webb	2	1
Young	1	1
Mehan	3	0
etc.		

circle the name of the appropriate correlation technique from these choices:
a. Pearson product-moment correlation
b. Biserial correlation
c. Tetrachoric correlation

10. Here is some data:

Quarterback	Height	Passing Yardage
Yarema	182 cm	2278 Yards
Chucklong	185 cm	2754 Yards
Ware	175 cm	1567 Yards
etc.		

circle the name of the appropriate correlation technique from these choices:
a. Pearson product-moment correlation
b. Biserial correlation
c. Tetrachoric correlation

APPENDIX L

Subjects' Written Comments for the Selection of Text Content

1. Defined and Concrete Treatment

S1: Both written + accompanying instructions stated that this was the info. we would be tested on. I did, however, read background info to give me a point of reference.

S2: They gave me the key words in the text.

S3: New information, objectives related to different types for posttest.

S4: I chose that content because the objective informed me what areas would be covered on the exercise/practice sheet. This helped me focuses my attention on what I needed to cover and understand. Any extra knowledge might have confused me or interfered with my ability to absorbed new information.

S5: Key words from the objective. Key vocabulary needed to understand explanation of the 3 correlations. So confusing - I wanted only to focus on the most relevant inf. so my mind could stay clear.

S6:
- I selected the main definitions.
- When examples make it easier to understand the point which is being developed.

S7:
1. I look at the test questions.
2. Because I knew next to nothing about correlations, I read the intro. paragraphs. The background+definitions were very helpful.
3. Then, I weeded out the extraneous + non-pertinent material. This deleted several of the correlation processes.
4. I eliminated the paragraphs under Pearson's product-moment model as the instruc. obj. indicated. I wouldn't need really need to know much about them; that is, learning would take a different direction.
5. The remaining paragraphs were the introductory paragraph+the 3 on each of the correlation processes considered to be important in the instruc. obj.

S8: Because the three types of correlations which were to be tested were given at the beginning of the exercise. I was looking for examples of two three types of correlations which were presented in the first instructions.

S9: It dealt with the 3 statistical tests that were listed in the instructional objective. Highlighting helped me to remember.

S10: Because it was comparing two variables that were the same or had the same correlation. It showed the relationship or correlation clearly.

S11: Because it directly related to the subject of correlation between 2 variables.

S12: According to the statement of the objective, I needed to know only about three specific types of correlation, so I read about only those three. In describing two of the three, an familiar term arose (artificial dichotomies). I felt I needed to know about it so I found the appropriate text (which I had briefly skimmed earlier) and read it. Since it was essential, I checked that section. I was already familiar with the essential concept of continuous variables, so I did not read that section, although I noted it from a brief skimming of the text.

S13: Each paragraph pertained to something in the instructional objective. The first couple gave definitions of the terms I would be needing. The last three were descriptions of the three correlations stated that I would be tested on. The instructions made it clear that I did not need to read all of the paragraphs. I only looked for material that was considered important via the instructional objective and the sample test instructions.

S14: I highlighted those to be tested, i.e., the 3 methods of doing correlation tests. The introduction is already understood, so I did not highlight it.

2. Defined Only treatment

S15: I highlighted the paragraphs that dealt with the terms in the instructional objective. I tried to only focus on the part of each paragraph that explained the five main terms that were stated. The instructional objective told me I would need to tell when to use a specific correlation technique - so that is what I focused on. I tried to memorized the usage for each correlation.

S16: The areas I highlighted were areas that I felt were uniquely significant to understanding each coefficient.

S17: Some was background information I needed to know and the rest related to the 3 tests we would be tested on.

S18: Chose key words either in title of each section or in a quick scan of the section looking for the three statistical tests we were told we would be tested on. Chose paragraph A because it defined correlation and paragraphs B,C, & D to answer myself "we" were using the same terminology to describe the 3 tests. I highlighted within sections words that clarified purpose of each test (when to use it) and strengths/weaknesses of each test to be further discriminating in selecting the appropriate test to use in the "practice". Scanned examples to "cement" the theory.

S19: I felt that every paragraph was relevant to the instructional objectives. One specific technique was discussed in each paragraph well enough for me to understand the basic use for the technique. The language was clear and understandable, and nearly every sentence was purposeful-the text was not wordy, but was quite to-the-point.

S20: The five paragraphs checked related to the objective

Continuous variables
Artificial dichotomy
Pearson - two continuous
Biserial continuous - art. dich.
Tet. - two art. dich.

S21: I scanned the words listed in objectives and read parts of these paragraphs concentrating on differences among Pearson, Tetra, and Biserial correlation.

S22: Because the instructional objective clearly stated what I would be required to know and what specifically I would be given (i.e., the choices, only the sets of numbers) to assist me in reaching my answer. The paragraphs I highlighted (checked) contained helpful information, definition, and examples so that I could retain the information for the "test".

S23: 1. It pertained specifically to the definition of terms that I will read an understanding too in order to then identify the different types of correlation of variables examples.
2. It explained specifically what the correlation involved and linked to the definition of terms in the objectives.

S24: I chose the content based on the frequency of usage.

S25: Because the ones I choose are relevant to the objectives.

S26: I chose those contents because educational researchers should learn about all those kinds of correlations. Knowing different statistical models, specifically correlation, will help the researcher to apply the appropriate model in a given context. Learning about all those models will make the instruction complete. one is not expected to master all the models, basic knowledge about all the models should be included in the instructional design.

S27: The objective stated (1) that only combination of continuous correlation and artificial dichotomy would appear on the test, and (2) that choices would be from Pearson-moment correlation, biserial, and tetrachoric whatevers. Since I didn't know from memory or application what any other stuff in #1 or #2 were about and which of them were a description of #1, I read those applying to both #1 & #2. I didn't read the other paragraphs because they weren't mentioned in #1 or #2 of the objective. I didn't even recall anything part #1 & #2 in the objective because I was so upset that I had to take a test on something I didn't know anything about. It took my awhile to calm down enough to take any information from the paragraph I was reading. I don't know I will retain the information because I didn't get a chance to practice anything before I took the "test."

S28: Understanding different correlations is important especially Pearson's Product Moment Correlation. The other correlations are not as applicable, and could be looked up in most statistics books anytime.

3. Concrete Only Treatment

S29: 1. Definitions are boring and lengthy.

2. I anticipated these will be examples.
3. The terminology made sense to me, so I decided to memorize the terms and from them to derive the meaning, rather than using the given definitions.

S30: The objective was to select an appropriate statistical correlation. I felt that a review of all correlations was necessary, as these are not all familiar to me.

S31: It discussed! -Two set of continuous scores
- Most commonly used formula.

S32: I think that the understanding of variables would be the first step for learning correlation. I think that the most widely used correlation techniques are most important in this text.

S33: Because the instructions said that the past test was about correlation (a different types of correlation). I also highlighted some on the definitions provided because the aided in my understanding of the different correlation types that I am not familiar with.

S34: The first paragraph was an overview of how the correlations work - to show relationships. The next three choices dealt with the tests that were named on the first sheet you gave us - describing the objectives and the post tests.

S35: First, the definition of some basic concepts and terms regarding correlation has been discussed. Then, 6 kinds of correlation methods are explained based on the above discussion, which draw a clear picture of both concept and application about the chosen topic.

S36: Because the instructions told me to look for those 3 areas only.

S37: Because the instructional objective explained that I would be tested an my ability to recognize when a certain technique would be applicable and circle the correct technique.

S38: As the objective of the handout is to know the correlational methods such as Pearson Product-Moment Correlation, Biserial Correlation, Tetra-Correlation, I have to pay attention to those words that are relevant to the objective.

S39: I first considered the instructional objective and then I highlighted the content that I thought would be most relevant. Time was also a factor in what I highlight.

S40: They were the 3 types listed in the instructions.

S41: I checked <u>all</u> paragraphs to refresh my memory. Even after 3 terms of statistics, correlation came quite early (full) and it was obvious that I could not recall from memory alone the different techniques. Even the simpler notions of "rank", "continuous variables", "dichotomies" etc. needed to be reviewed. As the instructional objective stated that I would be given some data and be asked to circle the best technique, I felt it important to be thorough. Having to read all the directions told me that I do not have an automatic grasp of correlation. I circle many key words so when I finish I could go back and review quickly my understanding. Admittedly, the names of the techniques were not clear, so I resorted to looking at the key words and matching them with name: For example

<u>Name</u>	<u>Variables</u>	
	Continuous	
Rho	Rank	True Dich/False
Biserial	True Dichotomy	True/True
Point Biserial	Artificial Dichotomy	Artificial/Artificial

S42: The items I chose were explanations of when the various types of correlations would be used. It applies to my instructional objective of choosing the proper correlational method for given data.

<u>4. Neither Defined nor Concrete Treatment</u>

S43: It was the only one that stated when a correlation technique would be used " ... would be used when ..." or words to that affect. The other paragraphs seemed to be explaining facts, i.e., correlational techniques rather than when you would use correlational techniques in the first place.

S44: The instructional objective mentioned that I should know when to use correlation techniques and the answer to this question is in paragraph A, that is when we want to know the relationship between two variables.

S45: Because it stated specific instances of use which I felt might be useful. The other paragraphs contained material of a more general nature (and/or definitions which I am familiar with at this time).

S46: Because I thought the content I check was the basic, but core concept to understand the correlation. The reason why I didn't mark on some content was that it was not necessary to learn for my practical benefit.

S47: The sections highlighted contained information about which type of correlation was used given the different types of data. The objective asked me to learn when to use correlational techniques which had to be done in context of understanding the different variables and how they are represented.

S48: Because it related to correlation technique used in various data. There were seven types of techniques used, all of which were developed or designed to draw correlations between variables, age, gender, test scores, etc. to help draw conclusions from data.

S49: Told me what I needed to know when I what a correlational figure did so now I know when to use it.

S50: Because it was the only content that directly matched the objective, in its most basic form.

S51: Because it told me when to use correlational techniques (when I want to find the degree of correlation between two variables).

S52: The content that gave basic information about correlation, dichotomy, etc.were important.

S53: I choose those content because they are related to the content about correlation.

S54: I choose the content I marked because it seems important for correlations. Anything that related to the 2 variables measured the relationship of - I checked.

S55: I chose all of the text as relevant because the instructional objective stated the learner was to know when it was appropriate to use correlational techniques. 7 different types of correlation were discussed, depending on the level of measurement of the 2 variables.

To know when each was appropriate, one needs to associate the type of correlation with the different possible levels of measurement. This require some rehearsal time for me since I have not worked with correlation for a year.

S56: Because those the content needed for the question given later.

APPENDIX M

Subjects' Written Comments for the Selection of Exercise

1. Defined and Concrete Treatment

S1: No particular reason. It looked a little more interesting I guess.

S2: The type of question will help me recall definition of the concept.

S3: I like seeing the example.

S4: I selected that exercise because it best fit what I had read about. The objective stated what I would be "tested" on and I felt the particular exercise would show me if I grasped the content which I read.

S5: It was most similar to the way I had set up my study pattern to learn the information.

S6: It doesn't require to remember too many details from the text.

S7: I thought I knew the answer.

S8: Because it matched the examples which were given in the original reading. Also the three choices in the 1st paper were the same three choices of correlation techniques which were in this exercise.

S9: The answers fit the material I had studied, in the form I studied it.

S10: Because it show the ranking of each country.

S11: Because it was a choice between 1 & 2 which I am most familiar with rank (Spearman) order versus nonrank (Pearson).

S12: It most accurately reflected the type of test the objective talked about. I rejected the others because:
- one represented a true/false question, not a multiple choice type that I expected from the objective
- one mentioned a type of correlation which I was told I didn't have to know about in the objective

- one gave data that was not appropriate for any of the three types of correlation I was told I would have to know about

S13: The exercise was an example of the post test stated in the example. It had the same variables listed.

S14: Because it tested what I am supposed to be tested.

2. defined Only Treatment

S15: I selected the exercise that I did because the data looked familiar to what I had been reading.

S16: Because I can use the either or alternative, I do not like process of elimination because these seems to be a tendency at times for these response categories to overlap or just almost seem like the right answer.

S17: The 3 tests that should be found is included on the final test.

S18: Because I learned the criteria for selection of each test so I selected the test form that allowed me to look at the "situation" and apply the criteria then select the test.

S19: Because while reading the text, I analyzed the data to be able to distinguish between the techniques. Words can sometimes be confusing, but numbers on paper should be straight-forward.

S20: The five paragraphs checked related to the objective
Continuous variables
Artificial dichotomy
Pearson - two continuous
Biserial continuous - art. dich.
Tet - two art. dich.

S21: 1 and 4 have names of correlation other than those in objective. As a exercise, I thought T-F types is easier to see feedback.

S22: I am a visual learner and I feel I have some photographic memory. Also, I like to see example and apply my knowledge before making my choice. I just felt the more information I had available the better I could/would do.

S23: It used the information in the instructional objectives in a similar fashion - Linking the name of the correlation to an example of data. - I work rather fitting examples to definitions.

S24: Because I can apply my understanding.

S25: Because the one I select is described in the content.

S26: I chose form 3 because I was expecting same tests that may deal with (mental) recall without engaging calculations since time is short for such exercise.

S27: It contained examples of both Pearson Product-Moment Correlation and artificially dichotomous whatevers.

S28: The correct answer was present and there were the fewest number of choices.

3. Concrete Only Treatment

S29: 1.It was the reflecting best the text read.
2.It included the names (terminology) I used to memorize the text, in the way I expected it.

S30: The objective is to name an appropriate correlation technique, and (2) is the only one which asks clearly & directly to do this.

S31: The most comfortably with continuous score (at least one). The three selections were (a,b,c) most familiar.

S32: It is appropriate to apply the understanding of variables.

S33: Because it was similar to sample shown in the general instruction and the samples I read in the text.

S34: I felt I had learned enough about a totally unfamiliar subject during my brief reading of it to have a basic idea of what they were about. I knew I hadn't learned anything that would help me apply the new knowledge. I wasn't even sure of what I had learned! I felt the true-false format would give me enough information to recall the little bit of knowledge I had gathered.

S35: Compared to the first question, I have more confidence in selecting question2, because it seems that I can have two answers in question1.

S36: Because this is the area of instruction I read on.

S37: Because the format allows me to determine based on the information which technique would be applicable given the type of data.

S38: Because the term was familiar to me, I wanted to know more about it.

S39: I was totally confused. I thought I remember the most information about the exercise I selected obviously. I was wrong because I failed the test.

S40: Biserial - easiest to identify scores/rank.

S41: The direction stated "to prepare you for test" selection 3 and 4 simply assessed memory and did not provide visual information (though would be easier to answer). Selection 1 seemed to provide a little bit more information than number 2 (told how many more countries -needed in case of a small n of less than 10) (provided one additional answer (4) compared to (3) in number 2).
Confusion: #1 said "statistical technique" which could mean all techniques.
#2 said "correlational technique" which would delimit and only give correlational techniques.

S42: Exercise 2 looked like it fit the description of my behavioral objective - choosing the correct correlational method for various forms/types of data.

4.Neither Defined nor Concrete Treatment

S43: It related most closely to the objective and content I selected and included words like "... is used when..."

S44: Because it make you practice when to use a specific kind of correlation technique.

S45: I chose 3 because of the word "when" in the question. If the objective is to know when, then that is the question to be specifically addressed.

S46: Because I like the type

S47: I selected exercise #1 because I can't select the correct answer better than when data/information is given rather than selecting T or F without an example.

S48: I chose the exercise because I thought I understand the material, apparently not, because I reversed thinking on all the question asked.

S49: I remember same thing about rank?

S50: Basically, it was just a matter of choosing one at random. My knowledge of correlation is not good enough to spend a lot of time trying to figure out on which test I'll do best - I think I'd do about the same on any of the tests.

S51: Because it related to correlational techniques.

S52: I selected the exercise because it had familiar looking data arranged in a format that is used regularly in my work related reading. The columns for rank and types data seemed familiar, therefore easy understand.

S53: I feel familiar with this kind of data analysis.

S54: I seem to remember a little something on ranks. Also it seems interesting because I haven't done this type of correlation.

S55: Q3 and Q4 were true & false. They did not ask the learner to choose among the different correlations, so these were ruled out.Q2 had fewer option (3) than did Q1 (4), so I thought the likelihood of choosing correctly to be less a matter of luck. Q1 asked which correlation measure was appropriate given data of certain level of measurement which tested on the objective.

S56: Because that exercise was the one I feel I understand relatively.

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